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ABSTRACT

This book describes the TYC21 project (Two-Year Colleges in the Twenty-First Century: Breaking Down Barriers), which provided a framework to implement reform in science, engineering, and physics education at two-year colleges via the cooperative efforts of faculty in cross-educational activities. The project sought to increase the quality of education for students in the sciences by addressing the prevalence of faculty isolation from other faculty, administrators, and from the larger professional community and societies. TYC21 brought together 15 regional coordinators, all physics faculty, and facilitated dialogue regarding physics pedagogy, the need for more personal and professional contact, and new opportunities to discover more about the physics community and teaching. TYC21 resulted in the discovery of regional identities, many of which masked a national interest, yet also demonstrated the value of collaboration, which resulted in a number of grants and an atmosphere where faculty could recognize the commonality of their teaching concerns. Most participants regarded TYC21 as a positive and empowering experience, although some physics educators still preferred isolation and non-collaboration. To decrease isolation, faculty members should attend and participate in local, regional, and/or national meetings, and regularly engage in dialogue about physics pedagogy. College administrators should institutionalize and implement professional development activities, improve the reward systems for faculty engaging in scholarship, and provide financial support for faculty to attend local and national meetings and workshops. (Contains 34 references.) (CB)

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A MODEL FOR REFORM

Two-Year Colleges in the Twenty-First Century: Breaking Down Barriers

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American Association of Physics Teachers

Two-Year Colleges in the Twenty-First Century:
Breaking Down Barriers

A MODEL FOR REFORM

TYC21

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American Association
of Physics Teachers

Edited by

James C. Palmer, Illinois State University

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Acknowledgements

"The Two-Year Colleges in the Twenty-First Century: Breaking Down Barriers (TYC21) will improve the quality of physics education in the United States by developing and enhancing communication among two-year college physics faculty." Thus began the vision statement drafted by the TYC21 steering committee in the Spring, 1995. During the next five years as a program of the American Association of Physics Teachers with funding from the National Science Foundation, Division of Undergraduate Education, the Committee guided the initiative to success. The TYC21 network, a coalition of fifteen regional networks, currently boasts more than 500 physics faculty from two-year colleges.

The five-year project was an evolutionary process producing a model for reform which has implications for all academic communities. In the chapters of this monograph, the Committee describes the roles of individual faculty members, regional communities and the national community in forging a personal network of physics faculty and the role of future leadership in sustaining collaborations among two-year colleges.

For their contributions to the preparation of this document we would especially like to thank the following persons:

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NOTES FROM THE EDITOR

James C. Palmer, Illinois State University

If the hallmark of professionalism is collective action for a greater good, the TYC21 project represents professionalism at its best. Directed from the start by and for community college physics teachers, the Project provided a networking structure that allowed otherwise isolated classroom teachers the opportunity to discuss their craft — teaching introductory physics to students at open-access two-year colleges. Over the course of the five-year project (1995-1999), approximately 25% of the nation's 3,300 community college physics teachers participated in TYC21 events. The result was a strengthened two-year college presence within the national community of college physics teachers.

This strengthened presence is long overdue. Community colleges enroll just under half (46%) of all first-time college students in the United States. Among first-time students at public institutions, 54% attend two-year colleges (Kojaku & Nuñez,1999, pp. 3, 7, 10). For many Americans, especially for those who do not go on to become physicists, it is the community college that provides a window to the world of physics. And among those who teach at the college level, it is the community college professorate that has the greatest collective experience in introducing physics to the citizenry. That experience must be tapped if the nation is to meet its goal of teaching physics to all students, not just to a select few.

Those who led and participated in the TYC21 Project organized themselves and their colleagues with this goal in mind. The chapters in this monograph, written by TYC21 leaders, trace the historical development of the project, describe the nuts and bolts of its operation, and assess its impact. Chapter 1, written by Rick Swanson and Alex Dickison, provides an overview of the project, noting the historical precedents that led to its development and summarizing key points about what the project participants learned about creating and sustaining an effective networking structure for community college teachers. Tom O'Kuma and John Enger follow in Chapter 2 with additional insights into the personal networks created during the course of the TYC21 project, which provided opportunities for face-to-face communication among teachers who often work alone in one-person physics departments. Next, Marv Nelson describes (in Chapter 3) how the TYC21 project operated at the grass-roots level within each of 15 geographic regions across the country. Chapter 4, written by Mary Beth Monroe, details how the national conferences complemented this regional activity. And in Chapter 5, Marie Plumb and Marv Nelson take an in-depth look at the actions taken at the regional levels to break professional isolation and address key issues in physics education.

The final two chapters are "white papers" commissioned during the course of the project. In Chapter 6, Rick Swanson and Alex Dickison return to the issue of networking, describing the model of professional communication that emerged during the course of the project. In Chapter 7, Mary Beth Monroe, John Enger, and Tom O'Kuma analyze the problem that led to the development of the TYC21 Project in the first place — the isolation that too often characterizes the professional lives of those who teach physics at community colleges.

These chapters offer a great deal of practical advice to others building similar professional networks. The authors note their failures as well as their successes. They are candid in their observation that while collaborative work is desirable, many in the teaching ranks prefer the comfort of anonymity. They emphasize that the TYC21 project was just a beginning, and that its true test lies in the willingness of participants to continue their networking without special project funding from the National Science Foundation.

But the essays that follow also say much about a group of educators whose contributions are too often overlooked — community college faculty members. Despite heavy teaching loads with students whose wide-ranging skills pose considerable challenges to the classroom teacher, the TYC21 participants took it upon themselves to strengthen their collective voice in local and national discussions of science education. This took personal commitment and a willingness to confront the long-held assumption — prevalent at many community colleges — that faculty commitment to the discipline undermines institutional commitment to the student. The TYC21 project puts the lie to this assumption and constitutes a milestone chapter in the life of a professoriate dedicated, after all, to bringing the higher learning to the community.

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PREFACE

TYC21: Looking Backward...Looking Forward

Bernard V. Khoury, AAPT, Executive Officer

Roles of Two Year Colleges

Colleges were originally established to provide professional opportunities to a select percentage of students. In America this percentage has been steadily expanding, often as a direct result of federal initiatives such as the 1861 Morill Act (which established the land-grant colleges), the GI bill of the mid-twentieth century, and the massive student aid programs of the past thirty years. But it was not until the growth of the community college movement that America truly provided universal access to higher education. Their very existence is premised on expanding educational opportunities. Like the schools, they are locally controlled providing area citizens with opportunities to pursue individual educational interests, enhance job skills, or complete the first two years of a baccalaureate program.

Now, just under 50 percent of the students who begin postsecondary studies for the first time do so in a community college. The percentage is even greater among students for whom access has always been problematic in this country: females, minorities, the economically disadvantaged and the elderly. In short, the community colleges have provided postsecondary educational opportunities precisely to those groups for whom the four-year college experience was remote or even inaccessible.

The two-year colleges are local more than they are regional and national. They emphasize access rather than selectivity. They focus more on improving the current status of their students than on identifying those students who can benefit from existing programs. They emphasize convenience to their students rather than convenience to their faculties. They use local faculty resources rather than seeking faculty from a national pool. They offer courses and programs convenient to the students rather than expecting students to accommodate to institutional decisions. They initiate and terminate courses in response to local priorities rather than to long term academic traditions. They provide job skills in response to the interests of students and local businesses, and they provide academic skills to students who intend to transfer to four-year colleges and universities. For many students, community colleges provide the only practical options for access to job training and to academic programs.

If America is the land of opportunity after opportunity, the two-year colleges are the institutions by which America instills the skills that make such opportunities a reality for many of our citizens.

Role of Professional Societies

While two-year colleges draw great strengths and benefits from their local orientation, this same local orientation makes it difficult for their faculty members to connect with colleagues at other two-year institutions. Because of the institution's local orientation, two-year college teachers focus on their own institutions and their own students. This local orientation is a kind of vertical alignment of perspectives.

This vertical perspective, however, stands in contrast to the horizontal perspective of academic disciplines (such as physics), a perspective that usually characterizes faculty members at four-year colleges and universities. The horizontal perspective is one in which connections among faculty members who teach the same discipline in different institutions are much stronger than the connections faculty members have with colleagues at their own institutions. It is precisely this horizontal perspective that accounts, at least partially, for the presence of professional societies; they provide the structure that fosters and sustains disciplinary connections across institutions.

While disciplinary oriented professional societies have helped to advance the disciplines by providing effective dissemination and rewards for progress in the discipline, they usually have not focused primary attention on the needs and priorities of the institutions. Hence, the disciplinary societies have often not provided much support to faculty in two-year colleges. As a consequence, the two-year college faculty is often isolated from the larger disciplinary community.

The project *Two-Year Colleges in the Twenty-First Century* (TYC21) was designed to address this issue in the field of physics. The leaders of the project were themselves community college faculty members who, in contrast to many of their peers, were very active in their professional society (The American Association of Physics Teachers). They were guided by a two-part vision. First, they felt that physics teachers in two-year colleges should develop continuing connections with their colleagues and use those connections to collectively improve teaching and learning in community college physics classes. Second, they felt that the activities of the professional society (the AAPT) would be enhanced by addition of the perspectives and involvement of two-year college faculty. Ultimately, of course, the hope was that student learning at all kinds of institutions would be improved by the unified attention of faculty at all kinds of institutions.

When it was founded seventy years ago, AAPT focussed primarily on teaching physics at the college and university level. Over the past 20 years, AAPT's membership among high school teachers has grown significantly. TYC21 offers yet another chapter in the expansion of AAPT's membership. An important corollary of TYC21's primary objective (i.e., the professional involvement of community college physics teachers) is, hopefully, an increased community college presence in AAPT's membership.

Physics for All

More so than other disciplines, physics has advanced by examining ever more precise questions about the physical universe. But this reductionist approach, which has characterized the rapid advancement of the research frontiers of our profession, does not work as a model for improving teaching. Advancements in teaching require a holistic approach, because student learning occurs largely as a result of connections between a student's experiences and the material to be learned. In contrast to the norms of the professional society, which has a well-accepted set of criteria for recognizing and rewarding disciplinary progress, progress in teaching and learning does not proceed according to universally applicable rules. It is oriented at the levels of the classroom, the institution, and the individual student.

While the percentage of high school students who take a physics course has increased dramatically in the past decade, that percentage is still well below one-third. Physics is still perceived (and in many cases is "marketed") as a selective course accessible to a limited percentage of students. In many institutions physics is studied in the twelfth grade only after the successful completion of several other science and math courses. This history, in which physics is seen as a "hard" subject accessible to a limited percentage of students, is a major problem still facing our discipline. This perceived selectivity of our discipline is in stark contrast to the recently articulated and widely accepted national priority that "all students" should learn science.

While very few people who would argue with the proposition that "all students can learn history…or civics…or math," one would not get universal assent to the proposition that "all students can learn physics." If we are truly to advance towards "physics for all," the two-year colleges and their faculties will be crucial to that objective.

The TYC21 Project

Two-year colleges play a singularly important role in education of millions of students. Their faculties have been isolated from colleagues in other two-year colleges and even more isolated from colleagues in four-year colleges and universities. These characteristics are incompatible with current national priorities to expand access to science and technology, to train additional teachers at all levels who will propagate those skills, and to assure that a skilled workforce is available to continue improvements in the national and global economy.

The TYC21 project has identified some of the barriers to involving two-year college physics teachers in the advancement of physics for all. The project has made major strides in encouraging these community college faculty members to see themselves as members of a national community of physics teachers rather than to isolate themselves in a local environment. A critical number of such teachers have been brought together through the project. They have grown to recognize that their accumulated skills are valuable assets that will benefit not only their own students but also the students and teachers in other institutions.

With all of its progress in addressing such cultural issues, TYC21 is only the beginning of a long-term effort for all of us to recognize that we owe our students a comprehensive approach to improved teaching and learning. AAPT, representing the best in physics teaching, needs to continue to encourage the intense involvement of two-year college faculty members in all of our activities. Those with interests in teaching physics must assure that the beauty of our discipline is shared with all students, including those who will not become professional physicists but who will become leaders in business, politics, journalism, humanities, and government. Without the support and involvement of our two-year colleges, such an undertaking will not be successful. With the support and involvement of our two-year colleges, we can begin this important effort with a reasonable likelihood of success.

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PROJECT SUMMARY

Jay Norton, University of Southern Mississippi (MS)

A National Science Foundation Division of Undergraduate Education grant (DUE - 9450160) supported the Two Year Colleges in the Twenty-First Century: Breaking Down Barriers project which has yielded the document, *TYC21: A Model for Reform*. This project provided a framework to implement reform in the domain of science, engineering and physics education via the cooperative efforts of a variety of faculty in empowering as well as cross educational activities. The TYC21 project sought to increase the quality of the educational experiences for students in the sciences by addressing problems identified as deterring the best performance of the faculty. Though this project focused on two-year college faculty, the resulting recommendations and information gathered could be extrapolated to a number of disciplines at all levels of education.

Conferences, meetings and reviews within the Science, Mathematics, Engineering and Technology (SME&T) communities from the early 1970s, and supported by later efforts such as the 1986 report "Undergraduate Science, Mathematics, and Engineering Education" (NSF 86-100) [the Neal Report] to the 1989 "Critical Issues in Two-Year College Physics and Astronomy – 1990 and Beyond" (NSF, AAPT sponsored conference 1989) identified the ever increasing importance of two-year colleges' role in the science education of American students, both traditional and non-traditional. While recognition of the role of the two-year colleges in science education may have been rather muted in the larger SME&T community, the National Science Foundation as well as participants in the exchanges in the late 1980s and early 1990s, including the American Association of Physics Teachers, were keenly aware of the potential strengths and short-comings of such a finding.

The two-year colleges were enrolling an estimated 44% of all entering college students. They were also often the source of science education for students going into teaching, non-science oriented fields, and those planning to continue on to four year institutions.

> **Two-year colleges, which provide access to higher education for those who might not otherwise have such opportunities, particularly minorities and low income groups, represent the last chance for many students to continue their formal education; further, they offer the first two years of college science, mathematics and engineering (Parilla, R. E. 1991, p. 2).**

The educational diversity and opportunity found in the two-year colleges could be (and should be) exploited to aid in retaining students in the sciences, as well as prepare a science literate citizenry. The explosion of science and technology following the second World War, and in particular since the 1970s, demands a science literacy beyond what most students were gaining in the then typical classroom. American society is still struggling with upgrading education to prepare students to be science literate citizens. Science educators have been faced with problems that seem to be indigenous to teaching, especially in the science disciplines and to two-year colleges specifically: faculty isolation from other faculty, from administrators, from the larger professional community and its societies (Alfred & Linder, 1992; Block, 1991; Massey, Wilger & Colbeck, Jul-Aug 1994; Tavel, 1991,1991a,1995).

The lack of communication among two-year physics faculty as well as with others suggested that resources of the larger science education community were not being employed at TYCs, because these resources were unknown, and alternately, the expertise of the two-year faculty was not available or recognized by the larger community. Students would be the ultimate victims of this unfortunate lack of communication and academic exchange among faculty. Recognizing this, NSF funded the AAPT sponsored Two-Year Colleges in the Twenty-First Century: Breaking Down Barriers (TYC21) project. Proposed in 1993 and funded in 1995 the project vision of the TYC21 steering committee (AAPT, 1995) stated:

> **The Two-Year College in the Twenty-First Century: Breaking Down Barriers (TYC21) will improve the quality of physics education in the United States by developing and enhancing communication among two-year college physics faculty.**
>
> **The project will motivate involvement among two-year college physics faculty members by creating opportunities to network and share ideas on a professional and personal level. TYC21 will increase opportunities for outreach and community partnerships, validate personal teaching experiences, and empower these two-year college teaching faculty within the whole physics community.**
>
> **By developing a strong, vigorous, and valuable network, the TYC21 project will become self-sustaining. Leaders will emerge and relationships will form that promote continuing opportunities for networking, communication, and dissemination of information. Through regional and national collaborative efforts, two-year college faculty members will become more visible within the physics community and the isolation experienced by many two-year college physics faculty members will be greatly reduced.**

Implementing the Project Vision

Instead of expecting faculty to resolve their isolation problems individually, the TYC21 project sought to make opportunities available by involving faculty in conversations, not about isolation, but about students, teaching and physics. To implement this approach the leadership of the project involved a small group of interested physics faculty in developing a network that could serve as the seed to a larger one. Identifying potential participants, and making personal contact with candidates, the steering committee began the process of finding the future leadership for the TYC physics community as well as the members who would create the infrastructure for the network. Key to the initial success of the project was the personal contact of recognized elders of the community with potential participants.

The steering committee members were active physics faculty who had previously conducted workshops, provided in-service opportunities or had established themselves as voices in the physics education family. As such, they had had contact with many physics faculty on various occasions, and were recognizable to potential participants, who usually reported being flattered or energized by the personal invitation to join the project. The steering committee identified 15 such candidates representing the entire United States as divided into 15 geographic regions. Due to population variances the size of some of the regions encompassed as much as one-fifth of the land mass of the United States, while other regions were single states. These 15 individuals, the regional coordinators (RCs), were processed through two working conferences, one prior to the actual funding of the project, to aid them in developing leadership skills, as well as educate them in the mechanics of planning and conducting meetings within their regions.

Two immediate concerns were identifying potential attendees, and creating programs that would attract them. It was clear from the initial reaction to the term "isolation" that discussion of it specifically was not going to attract physics faculty. Though issues of national concern were identified and planned to be a basis for regional activities, the state of isolation and the very nature of two-year colleges — as regional institutions to meet regional needs — the focus of regional meetings became what the regional participants determined was of interest to them.

Pre-dating the current level of electronic communication systems, locating physics faculty required a variety of methods, ranging from phone trees to exploiting existing faculty directories and enormous mailings. Initially, many TYC21 faculty did not have access to telecommunication devices more sophisticated than telephones. Further, experience suggested preliminary contact needed to be as personal as possible. Though the project never sought to reach every two-year college physics faculty, the RCs and their teams strongly felt such an effort was critical to the project, albeit an extremely frustrating undertaking.

The RCs and members of their regional teams, three individuals selected from participants in the various local meetings, were also brought together at national meetings to further enhance their organizational and communication skills, discuss plans for the future and exchange information. An essential aspect of the national meetings was the evaluation of activities undertaken and planned, as well as evaluation of the ongoing project. Every regional and national meeting offered new opportunities to discover more about the physics community and teaching.

TYC21 Results

This project addressed the need for more personal and professional contact, not only among TYC physics faculty but with other physics faculty, and the related communities. It demonstrates a model for outreach that depends upon a committed core of people who are willing to examine the interests and needs of diverse populations that ultimately have similar interests and dedications but have traditionally not been recognized. The leadership employed information uncovered along the way, continuously evaluating and revising to serve the mission. It became apparent that motivation emanates from individuals, but opportunities must be provided that appeal to individuals' motivation and encourage personal and professional development. TYC21 provided those opportunities, not just to TYC faculty but to the larger community as well. By opening dialogue among physics faculty, teaching activities have been affected on all levels and students will benefit. Some specific results include, but are not limited to the following:

- Discovery of the extreme regional identity of these faculty that masked a national interest. Discussions of "national" issues at regional meetings often did not receive positive response. However, many of the topics that were considered regional were actually national in nature – student preparation, funding, administrative support questions, salary, curriculum concerns and how to better involve the students in the classroom.

- The value of collaboration was demonstrated throughout the project. Outreach efforts resulted in cross institutional collaborations in several cases, and a number of grants. Further, these meetings created an atmosphere of comfort wherein the various physics faculty could begin to recognize the commonality of their teaching concerns.

- Some isolation problems could be solved by simple communication. TYC21 motivated physics faculty to seek relationships with their administrations, often discovering them to be very supportive and interested in the project.

- Empowerment involves self-recognition. The project provided tools for TYC faculty to realize their own expertise in teaching as well as their ability to seek and obtain grant funding from their institutions, and larger organizations such as NSF.

- Not all findings were encouraging; one disappointing result of the project was the recognition that there are physics faculty who seem to prefer isolation and non-participation. However, for the more than 500 TYC faulty who participated in project related activities, TYC21 was reported as a positive, empowering and enlightening experience.

Recommendations

These recommendations are a result of the information gathered over the course of the project and represent the efforts of many individuals and organizations, directly and indirectly. While the full report provides more complete recommendations, the following are key to the continued development of physics teaching faculty, both personal and professional, and therefore to the mission of improving science education for students. It should not be overlooked that the recommendations could be applied to any discipline, and any level of faculty.

To Individual Faculty Members:
- Attend and participate in local, regional and/or national meetings.
- Be enthusiastic and positive in your scholarly activities and/or professional development activities and share your knowledge and experience with others.
- Regularly engage in assessment and evaluation of physics pedagogy.
- Collect information concerning the entry level skills and career goals of your students and maintain follow-up records for students completing your courses.

To College Administrators:
- Provide email and world wide web access for all faculty from their offices and homes.
- Institutionalize and implement professional development activities with reasonable financial support for all college faculty.
- Improve the reward system for faculty engaging in scholarship.
- Provide financial support to faculty (part-time and full-time) for both local and national meetings/workshops.
- Institutionalize campus activities engaging all faculty (part-time and full-time) teaching SME&T courses.

To TYC21 Regions:

- Implement, on a periodic basis, communications engaging two-year college physics faculty at the local level.
- Cultivate activities and/or communications engaging faculty and students at other educational levels.
- Maintain communications, whether formal or informal, with faculty in other TYC21 regions.

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CHAPTER 1

An Overview of TYC21

Alexander Dickison, Seminole Community College (FL)
Rick Swanson, Sandhills Community College (WA)

Those who teach physics at the nation's community, technical, and junior colleges play an important role in enhancing scientific literacy. Numbers tell the story. Data reported by Kojaku and Nuñez (1999, pp. 3, 7, 10) reveal that 46% of all first-time college students enroll at community colleges, and when one looks only at public colleges and universities, the percentage is even higher (54%). Many of these students need remediation in mathematics, reading, and writing; of the first-time freshmen entering public two-year colleges in the fall of 1995, 20 percent took remedial reading classes, 25% took remedial writing classes, and 34% took remedial mathematics classes (Lewis & Farris, 1997, p. 10). These are the students who are most at risk of not gaining the scientific knowledge needed to understand and work in the modern world.

Recognizing this important role, the community college physics teachers participating in the TYC21 program have worked to strengthen their collective voice in the larger physics community. A primary goal has been to break down the isolation of these teachers who often work in one-person departments and who have limited opportunities to attend professional conferences. Accordingly, TYC21 established 15 regional networks of community college physics teachers nationwide, each with a regional coordinator who works with his or her fellow teachers to develop (from the ground up) opportunities for dialogue and networking among colleagues. (See Figure 1 for a map of the regions. See also Table 2 in Chapter Two for a list of the regional coordinators.) In addition, an overall steering committee bore the responsibility of connecting the regional networks into a national network that represents a new but experienced voice in the reform of science education.

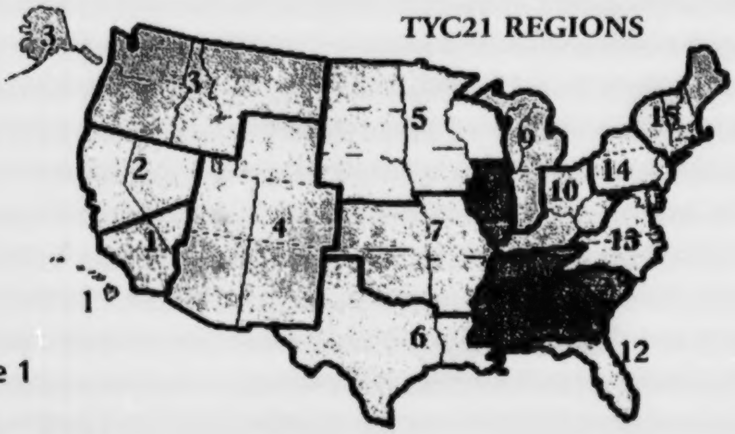

Figure 1

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TYC21's two-part intent, therefore, is to help individual faculty members develop personal networks that will enhance their capacity as teachers, and to increase the community college presence in national debates about science education. This chapter examines the historical precedents leading to TYC21's development and the overall plan for the project. It concludes with our observations about what TYC21 has taught us about creating and sustaining an effective networking structure for community college teachers.

Historical Precedents

As the number of community colleges grew in the 1960s and 1970s, so too did the challenges faced by two-year college physics teachers. Increased enrollments of nontraditional students, including those pursuing vocational training and those who left high school with insufficient academic skills, forced a reconsideration of traditional instruction and curriculum. Surveying the scene in 1972, Schrautemeier observed that physics teachers faced the task of diversifying course offerings and reaching out beyond the relatively small core of academically oriented students who had traditionally taken physics classes. He cited the need for courses that made physics accessible to non-science majors, for new approaches to teaching academically ill-prepared students, and for efforts to remake the image of physics in ways that would combat student fear of the subject and overcome popular misconceptions that physics had nothing to offer the average person. "If physics is to survive," Schrautemeier (1972, p. 3) wrote, "it must now become much more strongly committed to educating its public. In many cases, physics instructors in the community college must refuse to teach in the way they were taught. They must strive to make their courses so attractive that they are oversubscribed rather than undersubscribed. Alienated students must be reached and brought back into the fold."

The profession responded to these challenges with two national initiatives that were to be the precursors of the TYC21 project. The first entailed the workshops and meetings sponsored by the Panel on Physics in the Two-Year Colleges, which was established in 1968 by the federally funded Commission on College Physics. Designed specifically for the many new instructors that were being hired at the time, these workshops and meetings were usually hosted and organized by universities in states with extensive community college systems. Examples included computer workshops in Texas and Arizona, short courses in technical physics provided for faculty members in Oregon and California, summer institutes in New York, Saturday research seminars in Florida, and regular, ongoing meetings in Minnesota. They were held in most states where there were a significant number of two-year colleges and provided physics teachers with opportunities to meet each other and share their work.

The second early initiative was undertaken by the American Association of Physics Teachers (AAPT) through its Committee on Physics in Two-Year Colleges (CPTYC). The Committee met for the first time in 1970 and devoted considerable effort to creating physics modules for students who were not majoring in science and to helping faculty members use the computer as an instructional tool (Peckman, 1972). With the support of the Exxon Education Foundation, the AAPT also started the *CRPTYC* newsletter, which provided two-year college physics teachers with a medium for professional communication.

By the mid-1970s, it could safely be said that most two-year college physics instructors had the opportunity to network with one another on a state or regional basis. In addition, the *CRPTYC* newsletter provided the foundation for networking on a national scale. But funding for these efforts stopped in the middle to late 1970s. Many instructors attempted to maintain the networks that had been formed, although this proved difficult because most community colleges had limited travel budgets. Furthermore, many of the original two-year college physics teachers, who had been recruited from industry or from high schools, had started to retire. With the notable exception of the Pacific Northwest Association of College Physics (PNACP), which remained active in the Pacific Northwest, most networks that had formed in the late 1960s and early 1970s were slowly reduced in size.

The Emergence of TYC21

The challenges faced by community college physics teachers, however, did not go away. In 1989, the AAPT once again attempted to increase communication among two-year college physicists by sponsoring a three-day conference in Chevy Chase, MD, on "Critical Issues in Two-Year College Physics and Astronomy." Attended by 120 community college teachers, and funded largely through a National Science Foundation grant, the conference produced a series of recommendations aimed at two-year college administrators and faculty members, four-year colleges, and industry (Watkins, 1991). The conference attendees also attempted to initiate regional networks for professional development. But these networks never functioned, suggesting it would take much more than a three-day meeting to get them started.

Nevertheless, the conference *did* raise the visibility of the two-year college in the physics community. People started talking about what could and should be done. In 1991, Texas A&M University, with strong leadership from two-year college educators, began sponsoring two-week summer institutes for community college physics teachers in the state and (eventually) from all over the country. A national series of two-year college physics workshops, run entirely by community college physics teachers, was also initiated and funded by the National Science Foundation in the early 1990s. These intense, four-day workshops drew on the results of physics education research to acquaint participants with new teaching methods.

The success of these workshops led the AAPT to consider holding a second conference as a follow-up to its 1989 meeting of community college physics teachers. But it soon became apparent that occasional conferences weren't enough. What was really needed was the establishment of regional and national networks that would provide continuous, ongoing support for faculty members. The TYC21 project was therefore formalized at the AAPT's 1993 summer meeting in Bozeman, MT, where it was approved by the AAPT executive board. Eighteen months of behind-the-scenes planning followed, involving community college physics teachers as well as staff members from the AAPT and the NSF. Although the project was not officially funded until 1995, TYC21's first annual meeting was held in the summer of 1994 at Notre Dame University and supported by a special grant from the AAPT. Participants were introduced to the goals of TYC21, and both steering committee members and regional coordinators planned activities that would be undertaken after full funding had been secured.

The Project Plan

In 1995, TYC21 leaders began in earnest to motivate involvement among two-year college physics faculty members by creating opportunities to network with one another. A national vision for the project was established, along with corresponding goals (see Figure 2). In addition, a project plan was developed, resting on a three-part foundation: an organizational structure for regional and national networking; a focus on critical issues in physics education; and a series of national meetings.

Networking Structure

The TYC21 organizational structure consisted of a steering committee made up of the two principle investigators and six two-year college faculty members. Each of 15 regional coordinators, working with a mentor from the steering committee, was assigned responsibility to develop regional networks. In addition, each regional coordinator was expected to form a regional team made up of him or herself and three other two-year college physics teachers from within the region. Steering committee members and AAPT staff met with the regional coordinators in an August 1995 leadership meeting at Post Falls, ID, to help them determine the scope and

Figure 2

TYC21 NATIONAL VISION STATEMENT

"The Two-Year College in the Twenty-First Century: Breaking Down Barriers" (TYC21) will improve the quality of physics education in the United States by developing and enhancing communication among two-year college physics faculty. The project will motivate involvement among two-year college physics faculty members by creating opportunities to network and share ideas on a professional and personal level. TYC21 will increase opportunities for outreach and community partnerships, validate personal teaching experiences and empower these two-year college teaching faculty within the whole physics community. By developing a strong, vigorous, and valuable network, the TYC21 project will become self-sustaining. Leaders will emerge and relationships will form that will promote continuing opportunities for networking, communication, and dissemination of information. Through regional and national collaborative efforts, two-year college faculty members will become more visible within the physics community and the isolation experienced by many two-year college physics faculty members will be greatly reduced.

TYC21 NATIONAL GOALS

Goal One: Faculty Development. The project will build a special network among two-year college physics faculty for the purpose of:

a) Reducing the isolation felt by many two-year college faculty members;
b) Promoting among two-year college faculty an awareness of current developments in physics education research; and,
c) Encouraging two-year college faculty members to share their work within their wider discipline community.

Goal Two: Community Empowerment. The project will train, develop, and mentor new leaders to provide a stronger voice for the two-year college physics community for the purposes of:

a) Defining the characteristics and background of effective two-year college physics faculty;
b) Helping to better inform various constituencies (political, educational and business leadership at the local, state and national level) about:

    1) the role in which two-year colleges have been effective,
    2) the uniqueness of the two-year college student (and faculty member), and;

c) promoting guidelines for assessment of physics programs in two-year colleges.

nature of regional activities. These activities were to be developed from the ground up, not from the top down by TYC21's national leadership. But it was important to provide the regional coordinators with concrete ideas and support that leave them confident of their ability to generate meaningful activities while ate the time ensuring that regions had the flexibility to create networks that addressed local concerns.

Critical Issues

The principal investigators felt strongly that if effective networks were to be built and sustained, project activities at the national and regional levels could not be limited to two or three annual meetings. They felt that regional members should interact with each other between meetings, exchanging research, ideas, and findings on critical issues in physics education. The regional coordinators were encouraged to have their members decide on one or more critical issues that would be the focus of collaborative study. Among the many critical issues identified by the regions during the course of the TYC21 Project were the following: enhancing communication among community college physics teachers; dealing with underprepared students; pre- and post-testing of student ability; providing laboratory support; determining the rights and responsibilities of students; using instructional technology (including the Internet); and addressing differing student learning styles.

In addition, it was felt that regional and national meetings could be built on this work, offering members an opportunity to share the results of their investigations through papers, discussion panels, and other conference activities. Besides advancing knowledge about best practices in physics teaching and building strong, purposeful networking opportunities between conferences, the intent was to increase the presence of community college physics teachers in professional conferences. Too often these instructors do not give presentations at meetings because they think they are not doing anything "interesting."

National Meetings

From the fall of 1995 through the summer of 1998, the TYC21 program provided support for three national meetings and over 90 regional meetings. The national meetings became focal points for the development of the national network and for encouraging and empowering the development of the regional networks. At the end of the second national meeting, the steering committee turned over planning for the third meeting to the regional leadership, recognizing that the regional coordinators and their colleagues had emerged as pivotal players in the national TYC21 structure. As a result, the third meeting became the most successful of the national meetings, demonstrating the robust nature of the networks that had been established across the country. Interviews we conducted with regional coordinators yielded positive indications of the maturing leadership base that had been created by TYC21 networking. Regional coordinators provided realistic and sobering insights into the networking process. They recognized that creating and maintaining relationships among colleagues takes focus, attention to common interests, a lot of hard work. It was apparent from these interviews that the group of TYC21 regional coordinators represented a valuable, and possibly unique, resource of knowledge and expertise about the networking process.

What Has Been Realized Through TYC21: A Mixed Picture

The third national meeting ended on an almost euphoric note. Responses to a questionnaire administered by an external evaluator revealed the participants' feeling that that the TYC21 network had matured greatly. Of the 40 surveys returned, all indicated that the TYC21 project had contributed to building a network among two-year college faculty members, that the project had encouraged participants to share work within the wider disciplinary community, and that that project had helped mentor new leaders for the two-year college physics community. Open-ended comments identified progress as "astounding," "phenomenal," "an overwhelming success," and "beyond my expectations." All 40 respondents stated that their regions had plans to continue meetings after the funding ended.

There were also, however, indications of a more sobering realization: that networks, to be effective, actually have to do something. One participant stated, "Our network is complete as a discussion group but has not started to be an action group." Another recognized that, "Time will tell whether the organization is sustained and...produces further results." A third responded, "We progressed from fragmentation to cooperation and cohesion. Our cohesion is still tenuous. We need to nurture the network." If there is a disappointing feature of the nature of TYC networks, it lies in their as yet unproven ability to take action and produce meaningful results. Few of the regions were able to make significant progress on any issue. Several of the white papers created to address critical issues were of a quality that would be considered less than scholarly.

On the other hand, networking and contacts allowed TYC21 participants to get more involved with existing, grant-related efforts in the larger physics community. It helped to instill an "I-can-do-this" attitude that may pay more dividends in the future. And, perhaps most importantly, it helped us understand what it takes to develop a disciplinary network among community college teachers. Among the lessons learned about networking are the following (all drawn from conversations with the regional coordinators):

- **Provide training.** The TYC21 program goals and leadership structure provided a focus on the creation of networks. But even with enthusiastic volunteers, training on the process of networking was required. In many cases, training on simple ideas (such as how to develop a meeting agenda) helped regional leaders develop the confidence needed to initiate networking activities.

- **Facilitate personal interaction.** Personal, face-to-face contact is important. Regional coordinators continually stressed the need for faculty members to meet and interact with colleagues on a person-to-person basis. Electronic communications (such as listserves and web pages) facilitated networking in some cases, but not to the extent that had been hoped.

- **Invite member participation.** Consistent communication is important to keep less active participants informed and to encourage their participation. Many regional coordinators mentioned the importance of newsletters in this regard. But they cautioned that expectations need to be reasonable because of the heavy teaching loads maintained by community college faculty members. Most are at two-year colleges because they want to devote most of their energy toward teaching. In addition, most community college physics teachers are in small departments, and few have the flexibility to apply more than a small fraction of their energy to outside tasks.

- **Recognize the need for state or regional fiscal support.** The university model for getting networked groups to take on major projects or attract significant grants will not work for two-year colleges. Few of these institutions have infrastructures or departments that can support the administration of large grants. Nor do they typically have faculty members that can be given large amounts of release time to pursue projects. This support, even if minimal, from regional or state systems can make huge differences in the viability of two-year college networks. The TYC21 experience suggests that networks were more inclusive and robust in states like Kentucky, North Carolina, Florida, and Texas in which administrations provided mechanisms for discipline groups to interact.

- **Encourage attention to issues that uniquely affect community colleges.** Two-year college faculty members have difficulty addressing issues that are unique to them and their students. Most TYC21 efforts provided insights into issues already addressed by the larger discipline (in this case, physics). This is not necessarily a negative outcome, but it would have been nice to have seen greater attention to community college issues (such as the role of physics in two-year vocational/technical programs).

- **Form meaningful geographic regions.** Project organizers should not try to force a network where there is no reason for one. Some of the larger TYC21 geographical regions encompassed faculty members who were so widely separated from each other that networking was not feasible or even needed. For example, it may not be reasonable or appropriate to expect that Arkansas TYC faculty would form an effective network with Kansas TYC faculty.

It is one thing to recognize the need for faculty networking, quite another to facilitate that networking among busy and dispersed teachers. Though TYC21 did not achieve all that it could have, it did teach us about what contributes to and what impedes the development of strong, sustained networks. Future efforts to galvanize the collective energies of community college physics teachers will undoubtedly benefit from this pioneering work.

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CHAPTER 2

Building Personal Networks at the National and Regional Levels

John Enger, Northwest College (WY)
Thomas O'Kuma, Lee College (TX)

A primary goal of the TYC21 Project was to establish a personal network that (a) reduces the isolation felt by many faculty members who teach physics at two-year colleges, (b) promotes an awareness of current issues in physics curriculum development at two-year colleges, and (c) encourages two-year college faculty members to share their work within a wider disciplinary community. The term "personal" is central to TYC21, emphasizing face-to-face interactions that help faculty members become acquainted with one another and build a comfort level needed for ongoing communication. Through this networking, TYC21 intended to connect faculty members with colleagues who share the same problems and who, therefore, could identify with one another.

This personal interaction was the guiding principle behind the project's national and regional networks. Steps leading to both of these networks are described in this chapter. Their development is a case study of how community college faculty members within a particular discipline can structure opportunities (both nationally and locally) for ongoing, colleague-to-colleague communication.

The National Network

The national network developed in three phases. The first phase started during the early 1990s with discussions among a group of interested and informed community college physics faculty members who met informally at the national meetings of the American Association of Physics Teachers (AAPT). These individuals (who would later become members of TYC21's steering committee) recognized a need to expand their own networks of professional contacts among community college teachers and within the physics community generally. They realized that a personal network for community college physics teachers should have both a national and a regional component, with resources and support from both levels; that this network should begin with a small group of committed individuals and then expand to a larger group of colleagues; and that developing and sustaining the network would require strong leadership.

When the AAPT's executive board established TYC21's steering committee (SC) in 1993, the first phase of development ended and the second phase began. The executive board gave the steering committee the authority to obtain external funding and to formally build the network. The steering committee members (Table 1) served not only as the initial leaders of the project charged with building the network, but they also constituted the initial core of the network itself. The Chair of the Committee on Physics in Two-Year Colleges (CPTYC) was asked to serve as AAPT's liaison to the steering committee. The committee also included two designated "project directors" who had both the insight and the drive needed to build and run the network. These two individuals directed TYC21's efforts to improve the professional development of community college physics teachers, improve student learning in our classrooms and laboratories, and raise the visibility of two-year colleges within the physics community.

Table 1

STEERING COMMITTEE MEMBERS

Alexander Dickison	Seminole Community College (FL)	1993-2000
John Enger	Northwest College (WY)	1993-2000
Curt Hieggelke	Joliet Junior College (IL)	1993-1997
Scott Hildreth	Chabot College (CA)	1997-2000
Carol Lucey (project director)	Jamestown Community College (NY)	1993-1995
Mary Beth Monroe (project director)	Southwest Texas Junior College (TX)	1993-2000
Marvin Nelson (project director)	Green River Community College (WA)	1996-2000
Tom O'Kuma	Lee College (TX)	1993-2000
Marie Plumb	Jamestown Community College (NY)	1996-2000
Bob Speers	Firelands College — Bowling Green State University (OH)	1993-1995
Richard Swanson	Sandhills Community College (NC)	1995-2000

LIAISONS TO THE STEERING COMMITTEE FROM THE COMMITTEE ON PHYSICS IN TWO-YEAR COLLEGES (CPTYC)

Myra West	Kent State University, Stark Campus (OH)	1993-1994
George Tucker	Sage Junior College (NY)	1995-1996
Susie Evers	Panola Junior College (TX)	1997-1998
Paul D'Alessandris	Monroe Community College (NY)	1999-2000

During this second phase of TYC21's development, the steering committee realized the need for a connection between national and regional networking efforts. To make this connection, and to get the word out about the new project, the steering committee spent considerable time selecting the initial regional coordinators (Table 2). These individuals were chosen because of their visibility as

Table 2

REGIONAL COORDINATORS

Region 1	Myron Mann	Los Angeles Valley College (CA)	1994-2000
Region 2	Oshri Karmon	Diablo Valley College (CA)	1994-1996
	Scott Hildreth	Chabot College (CA)	1996-1997
	Tim Dave	Solano Community College (CA)	1997-2000
Region 3	Ken Gentilli	Tacoma Community College (WA)	1994-2000
Region 4	J.D. Mildrew	South Mountain Community College (AZ)	1994-2000
Region 5	Donald Skaar	Lakewood Community College (MN)	1994
	Aaron Wenger	Itasca Community College (MN)	1995-2000
Region 6	Susie Evers	Panola Junior College (TX)	1994-1997
	Jess Dowdy	Northeast TX Community College (TX)	1997-2000
Region 7	Bob Hunt	Johnson County Community College (KS)	1994-1998
	Todd Lief	Cloud County Community College (KS)	1998-2000
Region 8	John Popp	Moraine Valley Community College (IL)	1994-1997
	Howard Balfour	Moraine Valley Community College (IL)	1997-2000
Region 9	Patti Hughey	Lansing Community College (MI)	1994-2000
Region 10	Barbara Bates	Lakeland Community College (OH)	1994-2000
Region 11	Ali Yazdi	Jefferson State Community College (AL)	1994-2000
Region 12	Larry Bigelow	Seminole Community College (FL)	1994-1995
	Sherry Savdra	Lake Sumter Community College (FL)	1995-2000
Region 13	Chris Roddy	Sandhills Community College (NC)	1994-1995
	Mac Lafferty	Piedmont Virginia Community College (VA)	1995-1996
	Bill Warren	Lord Fairfax Community College (VA)	1997-2000
Region 14	Gordon Johnson	Westmoreland County Community College (PA)	1994-1996
	Paul D'Alessandris	Monroe Community College (NY)	1996-1998
	Carolyn Haas	Salem Community College (NJ)	1998-2000
Region 15	Judy Tavel	Dutchess Community College (NY)	1994-1996
	Tony Zito	Dutchess Community College (NY)	1997-2000

community college faculty members within their regions; because of their record of involvement in professional groups at the national and/or local levels; and because of their expressed desire to be part of the national network and to help build the regional networks. In order to forge connections between the steering committee members and the newly selected regional coordinators, the AAPT sponsored a leadership conference that involved both groups in August 1994. At the conference, participants spent considerable time planning the establishment of the regional networks.

Funding from the National Science Foundation (NSF) was secured in the fall of 1994, and the steering committee began additional efforts to build the national network. Both a project manager and an external evaluator were employed to provide additional support, guidance, and assessment. Steering committee members served as support persons for specific regions, and they developed a handbook and other documents that were designed to assist the regional coordinators. All of this work led up to a July 1995 leadership retreat at which the national network was solidified as close bonds were established between the steering committee members and the regional coordinators. Many skeptical retreat participants who had come to test the waters left with a great deal of enthusiasm.[1]

It was at this point that the third phase began. The national network, consisting of steering committee members and regional coordinators, once again expanded—this time to include regional team members. These individuals were initially selected by the regional coordinators with some assistance from the steering committee; later on, they were elected by regional members at large. These team members joined the steering committee members and the regional coordinators at the subsequent national TYC21 meetings held in the summers of 1996, 1997, and 1998. Over the course of the project a total of 82 regional team members attended these national gatherings, constituting a critical mass of faculty members dedicated to ending their isolation and improving physics education had been created.

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[1] Additional evidence of the strength of the national network could be seen in the Project's ability to survive key personnel changes. Just prior to the 1995 leadership retreat, one of the steering committee members resigned but was successfully replaced by a regional coordinator who wanted the opportunity to serve on the steering committee. Not long after the retreat, one of the two project directors resigned. This could have been disastrous, but the resignation allowed one of the steering committee members to assume the project director role. Clearly, the Project was becoming self-sustaining; the emerging national network was attracting (and perhaps developing) individuals with the leadership capacity needed to fill gaps that inevitably emerge over time.

Building the Regional Networks

As the national network was being formed, efforts were undertaken to form similar networks in 15 geographic regions across the country. The model of network development used at the national level (that is, expanding from a relatively small group to a larger one) was emulated at the regional level. But the regional networks differed from the national network in one significant way: they would rely on the personal desire and energy of the participants without financial incentives that were enjoyed at the national level through NSF support.

When trying to establish regional networks, the regional coordinators initially faced the problem of having virtually no information that they could use to identify fellow community college physics teachers within their regions. (This was certainly a sign of the professional isolation that the TYC21 project was designed to address.) The most reliable means of identifying potential TYC21 participants was to simply call each community college in the region. Once the region's physics teachers had been identified, the coordinator, working with a steering committee member, would typically invite two or three to become the initial regional team members who would organize the first regional meeting. These initial meetings were often modeled on those that the regional coordinators had experienced through their participation in TYC21's 1994 and 1995 national leadership meetings, the AAPT national and sectional meetings, the meetings sponsored by the Pacific Northwest Association of College Physics, or the meetings sponsored by the Physics Enhancement Project for Two-Year Colleges. After the first meeting, the regional participants themselves appointed the leadership teams.

Getting the word out about these initial meetings was a formidable task, given the scant communication between isolated physics teachers at disparate institutions. But the energetic work of the regional coordinators and team members, along with publicity in AAPT publications (the *Announcer* and *The Physics Teacher*), was enough to get the regional meetings started. (Though in some large geographic regions, the first meeting involved only those within a specific area that had a large concentration of community colleges.) The regional networks built from there and often extended beyond the two-year college community, involving high schools, industry partners, and university faculty members. Between 1995 and 1999, 93 regional meetings were convened. Meeting activities and presentations were designed to promote professional development, help participants improve their own classroom teaching, and increase discussion of critical issues facing community college physics teachers.

Sustaining the Networks

TYC21 was not meant as a permanent project. Rather, it was designed to begin a process of networking that could be sustained long after the project's completion. The expanded national and regional networks formed during the course of the project brought together core groups of faculty members who had not worked together previously and whose joint efforts helped reduce isolation, promote an awareness of curriculum development, and encourage faculty members to share their work within the larger physics community. TYC21 will be deemed a success to the extent that the momentum it generated facilitates continued networking under the stewardship of existing professional associations, notably the AAPT and its Committee on Physics in Two-Year Colleges.

CHAPTER 3

Regions: The Heart of TYC21

Marvin Nelson, Green River Community College (WA)

One of the primary questions facing steering committee members as they developed the structure of TYC21 was, "What is the best way to remove isolation as an issue facing two-year college physics faculty, develop networking as a natural mind set, and increase the visibility of the two-year college physics community?" A regional structure was thought to be the most appropriate way to begin interactions within the physics community. Furthermore, surveys conducted by Tavel (1995), along with discussions at meetings of the American Association of Physics Teachers (AAPT) in the early 1990s, established that a majority of physics departments have limited travel funds, impose heavy work loads, and employ only one full-time person. Criteria for a regional structure that would maximize the impact of TYC21 on the physics community therefore had to include relevance, convenience, minimum travel time, and low cost. These are the significant factors determining the degree to which many two-year-college physics teachers will participate in professional development.

Continuity was another long-term project goal. It was evident from the beginning of the project that the regional coordinators were committed to continuation beyond the funding period and sought ideas for meeting this goal. As a result, several different models of regional activities were instituted. Some models were based on the regional coordinators' experience in other organizations such as the Pacific Northwest Association for College Physics. Another common model was the traditional paper presentation. One year after the end of the TYC21 project, many regions continue to meet or are working on projects, which are in large part attributable to TYC21 (although the overall level of activity has declined). However, it is evident that the level of participation within the American Association of Physics Teachers (AAPT) at the national and section levels has increased since TYC21 began.

The Plan for Regional Networking

Fifteen regions were formed within the continental United States (see Figure 1 in Chapter One). Each region had roughly the same number of two-year colleges, and each contained at least one metropolitan center within the region. (Maria Bautista of Kapi'olani Community College, Hawaii. She heard about TYC21 while participating in the Physics Enhancement Program for Two Year Colleges (PEPTYC) meeting at Texas A&M University. She subsequently organized a very successful "sub-region" in the Hawaiian Islands and became active in the national components of the project.) But this regional distribution had several inherent limitations. Because the natural associations and directions of affiliation of those living in the areas close to boundary lines were not always known, the project had to be flexible, allowing people to participate in the regions that were most convenient for them. In a few instances, boundary lines were changed because of convenience or compatibility. A second obvious limitation lies in the disparity between regions in terms of geographic size. Less populated areas of the North Central and Western regions cover large land areas with low population densities and relatively few two-year colleges. Faculty members at many of these isolated schools found it difficult to attend regional TYC21 activities, which were usually concentrated in more populated areas that had several community colleges within a two-hour driving distance. (This was unfortunate, but the steering committee saw no reasonable alternative; a productive regional group requires a minimum number of people to form a core of active participants.) Finally, variations between the state systems of higher education made broad-based faculty participation a more challenging goal in some regions than in others. Texas and California, for example, have long-established, comprehensive community college systems. Other states have a more fragmented mix of two-year institutions; Wisconsin, with its technical colleges and university branch centers is an example.

As the previous chapters have indicated, a regional coordinator was identified for each region during the organizational phase of the project. Potential candidates included those with a demonstrated track record of involvement, as evidenced by participation in AAPT meetings, in the workshops offered by Curt Hieggelke and Tom O'Kuma on the current state of physics education, in activities sponsored by the PEPTYC project at Texas A&M University, or in other programs organized by and for community college physics teachers. Upon appointment, the regional coordinators were urged to identify two or three people who were willing to serve as regional team members. Working with their teams, the coordinators were to organize regional activities and develop a plan for each of their region's semi-annual meetings. These plans were to include goals, outcomes and a method for assessing the extent to which goals were met. In addition, each regional coordinator was to submit a report of regional activities after each meeting. Regions were allocated small amounts of money each year to cover meeting expenses and to provide modest honoraria for consultants with expertise in critical issues of importance to the region's members. For reasons that are still unclear, few regions used the funds available for consultants.

Each region was free to develop its own goals, outcomes and future direction. Such autonomy was felt necessary as a means of maximizing faculty participation during the early stages of the project. Steering committee members served as resource persons for the local regions, but the project's success would depend on the regional team members developing a plan that addressed the immediate concerns of their local colleagues and that convinced these colleagues that participation in TYC21 would be worthwhile. This does not mean that national issues were ignored. The steering committee recommended that each region should identify and study at least one critical issue of national importance. But attention to national issues would not occur without the freedom to pursue local interests as well. It is important to have a reason to meet and discuss, otherwise the group will eventually lose interest and become non-functioning.

Outcomes of Regional Activities

The regional coordinators must be given credit for the success of TYC21. Their collective regional vision was far more aggressive than the steering committee dared to consider during the organizational phase. This thesis is easily borne out by comparing regional activities with steering committee goals. In nearly all cases, regional coordinators were thinking of ways to involve everyone in their regions — a much more aggressive goal than the steering committee envisioned.

Regional leadership was consistent throughout the project. Only 3 of the 15 original people who agreed to serve as regional coordinators had dropped out for personal or professional reasons by the end of the first year. Eventually, three other regions had a change of leadership. However, two of those occurred because a regional coordinator moved up to fill a steering committee position. Not only did the majority of regional coordinators remain in their position, but, in addition, each developed and maintained an active regional organization. All 15 regions held 2 meetings during the first year. All but one region continued regional activities for the entire course of the project. On a few occasions one of the two planned yearly meetings was canceled because of weather or other legitimate reasons. Of course no region achieved the lofty goal of involving all eligible physics teachers, but a variety of methods was used to maximize participation. One region — Region 4 — had a network predating TYC21 that involved mathematics and physics instructors in high schools, two-year colleges and universities in the Phoenix, AZ area. Separate TYC21 meetings were stopped after the first year because they did not attract any new participants. However, participation of two-year college physics teachers continued in the existing Maricopa County organization.

Diversity has been used as a one-word descriptor for two-year college students. It is also an apt descriptor of the TYC21 regions, which varied in terms of leadership structure, geographic size, and previous history of collegial interaction. All contributed to the diversity within TYC21 and led regional teams to take a variety of approaches to organizing meetings and securing the participation of colleagues. Regional variations also added a level of richness to discussions at the national meetings.

Regional leadership took on a variety of appearances. In a few instances the regional coordinator did most of the preparatory work for the regional activities with minimal help and guidance from others. In many instances these same regions had difficulty bringing a full team to the national meeting (although other factors beyond the coordinator's control, such as summer teaching requirements, may have contributed to the problem). Several other regions maintained the same team with minimal changes in leadership for the duration of the project, while other regions rotated teams members on a frequent schedule. In one case, Region 3, three additional members were elected to the team each year, thereby allowing more people to serve in a leadership role. The newly elected members were slated to be the representatives at the next national meeting, should their schedules allow.

Arrangements and formats for the semi-annual meetings also varied greatly. Several regions held their meetings in conjunction with AAPT section meetings; in these cases, time was set aside for two-year college faculty members — and other interested people — to meet separately. Other regions held one meeting with an AAPT section but convened the second as a stand-alone TYC21 event. Still others held both semi-annual meetings as stand-alone TYC21 conferences.

Holding meetings at various locations within a region was another method used to broaden participation, as was holding meetings at sites in adjoining states. Region 5 developed one of the most unique approaches to involving physics teachers, employing the Interactive Television (ITV) system that links all Minnesota two-year colleges. Aaron Wenger, Regional Coordinator for Region 5, organized a statewide meeting using the ITV system. Enough sites around the state were linked so that travel time was minimized for those wishing to participate. He also used the ITV system to link with two sites in Region 7: Northern Oklahoma Community College and Longview Community College.

Isolation was one of the primary factors determining the format and focus of the early regional meetings. Early meetings in regions characterized by high levels of isolation concentrated on helping participants become acquainted with one another, and in subsequent meetings participants focused on the improvement of teaching and learning in their own classrooms. Most of the participants in these regions chose not to involve themselves in discussions of critical issues that have a national impact. Instead, they focused on local classroom concerns without considering how those local concerns may have national implications. (Interestingly, TYC21 participants in high population areas such as the San Francisco Bay Area and the Greater Kansas City Metropolitan area reported that they had known very few other two-year college physics teachers prior to the start of the project. Previously, there had simply been no reason to meet.)

In contrast, regions that had a previous history of involving faculty members in professional meetings entered more readily into discussions of national issues. For example, North Carolina two-year college physics teachers had previously worked together on topics involving technical physics. When TYC21 began, they were ready to focus on the specific task of gathering data from industrial applications to form problems that involve real-world applications. Texas is another example. It has a very active AAPT section, and Texas A&M University has been the site of PEPTYC, a program for two-year college physics teachers. While no formal network of community college physics teachers had been established in Texas, some degree of rapport already existed prior to the beginning of TYC21. This allowed project participants to focus at a very early point on a specific critical issue (parity for lecture and laboratory contact hours). Similarly, faculty members in Region 3 had had a chance to get to know one another through their involvement in the Pacific Northwest Association for College Physics (PNACP), which had been active for nearly 30 years prior to the start of TYC21. Two-year college people from this five-state region consistently attend PNACP's annual meetings and have been involved in leadership roles for the entire time. (PNACP's Board of Directors includes two seats specifically for two-year college personnel, and two different two-year college people have served as the Board's chairperson.) Thus, TYC21 participants in the Pacific Northwest had a head start in developing a functioning group. Soon after the start of TYC21, they began work on their regional project: identifying minimum outcomes for the algebra and trigonometry- based physics sequence.

A discussion of regional successes would be remiss if the significant contributions by the TYC21 Project Manager and AAPT Executive Office Staff were not included. The importance of having a full-time project coordinator cannot be overstated. She served as the contact person for the regional coordinators and for anyone interested in obtaining information about TYC21. Keeping abreast of regional activities allowed her to answer wide-ranging questions concerning the TYC21 Project. She was the editor of Connections, the newsletter for TYC21. The newsletter served as the TYC21 communication link to the national two-year college physics community and to other friends. She also served as the project's archivist. The AAPT office staff was very supportive and willing to help when needed. They were especially instrumental in preparing national meetings and seeing that they went smoothly. This support was invaluable for a project of this scope.

Regional Activity in the Post-Funding Period.

It is too early to make many judgments concerning the long-term impact of the project on continued interregional and intraregional networking. But a few "good-news/bad-news" observations can be made. The bad news is that, overall, regional activity has decreased. Many regions have not continued regularly scheduled meetings, though anecdotal evidence suggests that faculty interaction initiated by the TYC21 project in these regions may be continuing through increased participation in national or sectional meetings of the AAPT. The good news is that as many as seven regions are continuing an unbroken string of meetings or workshops.

The steering committee offered the regions small stipends that could be used to take final steps toward developing self-sustaining networks that promote professional development while at the same time furthering faculty involvement in the study of critical issues previously identified by the two-year college physics community. Three stipends were awarded. Two were for planning – one for identifying ways in which two-year colleges can best educate prospective teachers, the other had a two pronged goal of developing strategies that would be used to: a) involve the business community in two-year college physics programs, and b) identify ways to acquaint new teachers with recent advances in physics education and their implications for the classroom. The third stipend is for a workshop to develop classroom activities that apply physics concepts to real-world events. All are being implemented at the present time.

Summary

Has the project been successful at the grassroots level? Anecdotal evidence suggests a strong yes. Attendees to regional and national meetings have indicated that regional activities have had a profound effect on their teaching and on their interactions with colleagues. ("Now I feel as if I have colleagues," wrote one TYC21 participant who is from a one-person physics department.) Many other written and oral comments suggest the positive impact of TYC21 on individual faculty members. In a letter written to this author, Tim Dave, Coordinator for Region 2, sums up the positive view held by many participants:

> **"TYC21 has had a profound impact on Region 2, we are here in the most technological part of the country with companies that have pioneered communication and e-mail, and yet with all this, before TYC21 there was little communication between those who teach physics in our area. It can be summed up quite simply, we now talk...we now communicate we now exchange ideas and teaching strategies. TYC21 has opened up a new world for us but most of all it has provided us with tools to be better teachers."**

These and other statements like them are encouraging. Anecdotal evidence suggests that the National Science Foundation's support of two-year college physics programs has had a profound effect in the teaching and learning of physics in many colleges around the nation. Some collegial discourse has begun. A follow-up study of TYC21 participants will be needed to actually determine how the increased collegiality fostered by the program enhances student learning and increases the voice of community college faculty members in the larger physics community.

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"By not actively learning about and interacting with other physics teaching scholars, we set artificial limits on our ability to improve physics education in our culture." (Karen Johnston, 1996, n.p.)

CHAPTER 4

Empowering A Community: The Role of National Conferences

Mary Beth Monroe, Southwest Texas Junior College (TX)

"The Two Year College in the Twenty First Century" project, known by its participants as "TYC21," was an unusual project from the perspectives of both the American Association of Physics Teachers (AAPT) and the National Science Foundation (NSF). Funded by the NSF Division of Undergraduate Education and administered by the AAPT, TYC21's purpose was not to develop new curricula or teaching strategies. Rather, TYC21 proposed to initiate reform in introductory physics education by empowering the community college physics faculty, transforming it from a group of isolated teachers to a professional community of scholars who collectively study the art and science of teaching physics.

The project was designed and carried out by community college physics teachers who saw a gap between the limited voice they had in the physics community and their potential to make real contributions to the national goal of increasing the scientific literacy of all college students. They recognized that their singular focus on teaching at institutions that serve diverse students in both academic and vocational/technical curricula make them vitally important players in education reform. Yet they also realized that the potential contributions of the two-year college faculty to national discussions of physics education had not been fully realized. Two-year colleges do not have a highly visible role in national discussions of science education – a problem that was recognized, perhaps for the first time, by participants at AAPT's 1989 conference on "Physics and Astronomy in Two-Year Colleges." Furthermore, the physics teachers at these institutions often work alone, rarely collaborating with each other outside of the classroom. While this isolation is more or less characteristic of all college teachers, it is particularly extensive at two-year colleges where teachers are not expected to publish or engage in research. The missions of two-year colleges do not promote scholarship beyond classroom teaching, and although faculty members in vocational/technical programs consult representatives from the workplace via advisory committees, college administrations do not actively encourage their academic faculty members to engage in scholarly partnerships or collaborations outside of the institution. These activities are often viewed as the sole province of the college's mid-management team, not of classroom teachers. As a consequence, relatively few faculty members take the initiative to pursue professional development or outreach.

The TYC21 project therefore sought to bring the faculty together in ways that would increase its voice within the larger physics community. The project's national conferences provided the opportunity for community college physics teachers to meet together, apart from faculty members representing other disciplines and other educational levels, to address their own professional development and empowerment. During the tenure of the TYC21 program, the project directors, managers, and steering committee members organized and hosted six meetings with representative participation from each of the fifteen TYC21 regions:

- Leadership Conference, University of Notre Dame, 1994
- Leadership Retreat, Post Falls, ID, 1995
- National Meeting 1: "Realizing a Vision," University of Maryland, 1996
- National Meeting 2: "Focus on Action," Denver, CO, 1997
- National Meeting 3: "Partners in Scholarship," Nebraska City, NE, 1998
- "A Vision for Tomorrow": Fort Worth, TX, 1999

These conferences were sequential in nature, each building upon the outcomes of the previous meetings and guiding the formation of an empowered scholarly community.

Commitment and Team Building at the Notre Dame Leadership Conference (1994) and the Post Falls Leadership Retreat (1995)

The first meeting was held in the summer of 1994 on the campus of Notre Dame University, before National Science Foundation (NSF) funding for the project had been officially secured. This conference, subsidized by a special grant from the AAPT, brought together 25 community college physics teachers who shared the common goal of improving student learning. Speakers from both the four-year and two-year college communities helped trigger a sense of shared identity among the participants as professionals who make physics accessible to community college students. Inspired by the conference sessions and group activities, the participants recognized their potential as a community that can collectively improve physics education. But more importantly, these representatives from two-year colleges determined that if this professional community were to take on a visible and influential role in science education, the initiative must necessarily begin with them. By meeting's end, the steering committee members and 15 regional coordinators unanimously and enthusiastically voiced their ***commitment*** to organize regional meetings addressing introductory physics education.

In August 1995, after the NSF announced the award of funding for the TYC21 project, the steering committee members and the regional coordinators met for a second time in Post Falls, ID, to formally launch the national networking project. The goals of this meeting addressed the ***team building*** that would be needed to form the regional networks (discussed in Chapter 3). Although linked by a common desire to improve the teaching and learning of physics, the participants in the Post Falls meeting arrived with little understanding of how the creation of regional networks could foster a reform in physics education – even though the first set of regional meetings were to begin within two months! Consequently, the steering committee members developed many working group sessions that were designed to forge a team among the regional coordinators while instructing them in the logistics of the project's three-year networking plan. Session leaders also modeled the skills that the regional coordinators would utilize to build the local networks.

These two conferences, the Notre Dame Leadership Conference and the Post Falls Retreat, produced a leadership community among the physics teachers, committed to identifying and breaking the barriers of academic isolation. The participants, like most teachers at two-year colleges, worked independently and alone, generally not seeking collaboration or cooperation outside their own departments. For the most part these faculty members were not cognizant of their own isolation, nor did they realize the impact of this isolation on their performance as teachers. Three years after the Notre Dame conference, Ann Brennan, TYC21 project manager from 1995 to 1997, commented in retrospect that "the community college faculty had to become a 'little un-isolated' before they could realize their isolation" (personal communication, September 24, 1997).

Collaboration at the First Three National Meetings, 1995-1998

After the Post Falls conference, the TYC21 project had three meeting cycles from the fall of 1995 through August 1998. Each cycle consisted of two sets of local meetings in each of the program's 15 regions and concluded with a national conference. In order to foster leadership at the regional level while at the same time broadening the base of the national network, the national gatherings were expanded to include three locally elected delegates from each of the 15 TYC21 regions, as well as the steering committee members and the regional coordinators. Consequently these conferences, each including 60 community college faculty members who taught physics, were nicknamed "National Meetings" and were routinely called "National Meeting 1," "National Meeting 2," and "National Meeting 3."

During the planning stages of TYC21, the steering committee devoted a great deal of time to considering the nature of these national forums. After all, professional organizations such as the AAPT, the American Association for the Advancement of Science, the National Science Teachers Association, and the American Physical Society had been hosting professional meetings for many years. Regrettably, these meetings had not attracted large numbers of community college teachers. Therefore, the committee concluded that the TYC21 National Meetings must have a different "personality" that would attract participants over the term of the AAPT program. This personality is reflected in the scheduling of the meetings, in their focus on concerns of interest to community college physics teachers, and — most importantly — in their emphasis on an end goal: helping regional coordinators and regional team members develop an empowered community of scholars at the grass-roots level.

Scheduling

Judith Tavel's national surveys of the physics faculty at two-year colleges, conducted in the early 1990s, provided some insight into what it would take to recruit participants (Tavel, 1995). The faculty often reported that its lack of involvement in professional meetings could be attributed to limited travel funds and to the difficulty of finding colleagues who could cover missed classes during the travel period. (Most community colleges have single-member physics departments.) Consequently, TYC21 provided funding for travel, room, and board for all participants at its national conferences. In addition, these meetings were scheduled in late summer and held in tandem with AAPT's annual summer conference. There were two reasons for this. First, the faculty indicated that meetings held in the late summer would pose the fewest conflicts with teaching schedules. (In order to minimize the inconvenience of those who did teach in the late summer, the national meetings, which lasted for four days, were held over a long weekend.) Second, holding the meetings in conjunction with the AAPT summer conferences would allow TYC21 participants to attend at least some of the AAPT meeting, giving them the opportunity to interact and expand their networks with high school and four-year college colleagues.

A Focus on Teaching Physics

Workshop sessions highlighting recent innovations in physics teaching were a key component of the national meetings. These sessions made the national meetings immediately relevant to community college physics teachers and were a natural incentive for securing their participation. After all, teaching physics is what concerns TYC21 participants the most; it is the activity that they are most comfortable talking about. The Meetings gave the participants an opportunity to discuss new ideas with colleagues and to assess the appropriateness of instructional innovations within their own classrooms. While the sessions on teaching at the first national meeting were conducted by recognized leaders in physics education and physics education research (such Priscilla Laws, Alan Van Heuvelen, James Minstrell), the sessions scheduled during the second and third meetings were developed and led by two-year college teachers themselves. This in itself was a sign of the growing sense of community and empowerment that developed among TYC21 participants over the course of the project.

Goal Orientation

The TYC21 National Meetings, unlike the annual conferences of most professional organizations, were a sequence of gatherings leading to a defined outcome – the development of personal networks among community college physics teachers as well as the development of a core of leaders within this important group of educators. While professional organizations recognize the benefits accrued to educators through academic partnerships and networks, their meetings provide general professional development without specifically defined outcomes and many do not publish proceedings. This was not the case with TYC21; the National Meetings were a means toward the project's end, and the proceedings for each national meeting were compiled by the AAPT.

In order to achieve the project goals, the national meetings were designed as four-day, working retreats that (a) modeled activities that could be used at regional meetings and (b) established a sense of community that team members could carry back to their regional colleagues. Designing the meetings as retreats may at first glance seem to contradict the project's emphasis on networking. But students of the TYC21 reform effort must recall that the steering committee members, regional coordinators, and regional team members who convened at the national meetings had themselves worked largely in isolation. They had to "un-isolate" themselves before they could help others do the same. As Jay Norton (1999, p. 3) observed in her external evaluation of the project,

> **Limiting these meetings to two year [college] faculty allowed them to become comfortable with one another, to work for a common base, to compare notes with people working on many of the same problems and concerns. It allowed a starting point from which the participants could grow and develop.**

In addition, the national meetings emphasized scholarship in ways that would help local regions carry out an important charge – identifying an issue of common interest to teachers in the region, developing an action plan for addressing the issue, and preparing a white paper summarizing findings and results. Work on these white papers was not simply an academic exercise. It was deliberately built into the TYC21 project design under the assumption that collegial development of a scholarly product — not simply conversation — was necessary to the formation of the networks that the project sought to build. Accordingly, the national meetings were designed (in part) to help regional coordinators and team members develop their capacity to lead colleagues toward greater scholarly involvement. They also led participants to the realization that although the term "scholarship" is not often associated with classroom teachers, community college faculty members have much to contribute to scholarship on science education.

For example, two invited speakers at National Meeting 1, "Realizing a Vision," issued calls for increased scholarly activity. The opening plenary speaker, James Palmer of Illinois State University, reminded the teachers of the lack of visibility of the two-year college community in the larger science education communities (Palmer, 1996). At the closing session, Karen Johnston of North Carolina State University (and a former AAPT president) issued a challenge to the Meeting participants: "If you are not actively involved in a scholarly endeavor larger than your own classroom, get involved... On the other hand, if you've been involved in these projects and initiatives for some time, take a leadership role and identify someone who has not and work together" (Johnston, 1996, p.). The first national meeting also featured Melvin George, Chairperson of the Review Panel of Undergraduate Education of the National Science Foundation. He presented an excellent model for researching and addressing issues critical to improving physics education and emphasized a key point in the panel's final report: that community colleges are in a significant position to implement changes that can help all students learn physics (Committee on the Review of Undergraduate Education, 1996).

The theme of scholarship continued during National Meetings 2 ("Focus on Action") and National Meeting 3 ("Partners in Scholarship"). At National Meeting 2, participants looked within the community college system, showing that its focus on teaching, its wide-ranging curricula, and its diverse student population afford faculty members opportunities for research in science education that aren't readily available to faculty members at four-year colleges. Invited speakers, most of whom were two-year college physics teachers, described examples of community college scholarship that involved such activities as partnerships with industry, the preparation of proposals for corporate funding, and the design of curricula that are sensitive to underrepresented students. One year later, National Meeting 3 celebrated the personal networks that faculty members had developed in their regions and showcased the scholarship occurring within two-year colleges across the country. All sessions in the third meeting were designed and carried out by the two-year college teachers themselves. Of the 60 participants at the meeting, 39 had some part on the program. These faculty members organized the sessions, led group sessions and presented workshops on teaching innovations that they had developed.

The Last National Conference: Charting Future Directions

The three National Meetings provided community college physics teachers with opportunities to expand their agendas, broaden their experience with scholarship, and realize that talking and working with other physics teachers does enhance teaching and learning in their own classrooms. But if regional and cross-regional conversations are to continue, so must the deliberate training of new faculty members in the reasons for these activities. The goals of future meetings, both regionally and nationally, must be relevant to the faculty in ways that will lead to sustained and even greater scholarly effort. As the external evaluation of the project indicates, "networking is not a finite activity" (Norton, 1999, p.3).

Hence TYC21's last national conference, held in April 1999, was designed to chart the future direction of the newly empowered faculty over the next five years. The name of the meeting, "A Vision for Tomorrow," aptly denotes the cyclical nature of establishing and maintaining a network. Although National Meeting 3 was deemed successful, the project directors realized that the community of teachers needed a structural transition from the funded project to the ongoing, self-sustaining network. A new beginning meant a new vision.

Up to this point, the TYC21 project had been guided by the vision statement drafted and adopted by the TYC21 steering committee in March 1995 after NSF funding for the project had been announced. (See Chapter 1, pp. 17.) It was now time for the physics teachers to define their own vision, one that would guide further development of the network for the next five years. Accordingly, the 40 community college physics teachers attending the meeting drafted the following vision statement:

> **As two-year college members of the physics community, we need to actively communicate and promote our belief that physics is an important part of all students' education. Further, we believe that physics teachers who regularly communicate with each other can share ideas and provide a better set of learning opportunities for their students. Our network of physicists will sustain local and national conversations and activities about methods and styles of learning and teaching. These conversations and activities will support scholarship that is widely available, easily accessible and invites comment and collaboration.**

They also considered the question, "What should we in two-year colleges be doing to help improve the learning of our students?" Their responses led to the specification of five areas that the two-year college physics community will target for action during the next five years:

1. **Linkages between Two-Year Colleges and Future Teachers**
2. **Directions for Interdisciplinary Science**
3. **Physics for the General Populace**
4. **Strategies to Help Under-represented Students**
5. **Assessment**

While it is too early to determine how the networks developed during the course of TYC21 project will evolve, the project did at least end with eye toward the future.

A New Voice

The success of TYC21 in creating a national, but personal, network is without a doubt due to the common vision and thrust of its leaders. Possibly the most significant attribute of the program's national conferences was the opportunity for teachers to confer with one another, on a face-to-face basis, about issues that were important to them. The participants, representing all parts of the United States, realized that they were striving to attain the same goal: quality teaching and learning in the physics classrooms. What the participants acquired during these conferences was an enhanced understanding of the common problems affecting their classrooms and a national platform for the discussion and study of those problems.

The TYC21 project thus produced an empowered community that is now venturing out as a leader in science, mathematics, engineering and technology education. The success of this venture depends on the maturity of the new leaders that emerged within 15 regions and of their ability to guard against the return of isolation. We in the two-year colleges have long recognized the key role our institutions play in bringing together the private sector (business and industry) and the academy. The diversity of our colleges affords us the opportunity to make a difference, as a community; together we **can** contribute to educational reform. As Richard J. Coley (2000) of the Educational Testing Service observes in *The American Community College Turns 100*, community colleges "maintain open channels for individuals, enhancing the social mobility that has characterized America; and they accept the idea that society can be better, just as individuals can better their lot within it."

TYC21 has successfully chipped away at the wall of isolation that stands between us and the broader science education community. We who teach physics at two-year colleges have come to understand and appreciate our responsibility to contribute to academic change while safeguarding the quality and relevance of physics education **for all students** in an ever-changing world.

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CHAPTER 5

Critical Issues in Two-Year Colleges: A Summary of Regional Actions

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Marie Plumb, Jamestown Community College (NY)

Improving physics education at two-year colleges by encouraging the faculty to critically examine teaching and learning practices was a major focus of the TYC21 initiative. The original idea for TYC21 emerged at the 1989 conference on "Critical Issues in Two-Year College Physics and Astronomy," which was funded by the National Science Foundation (NSF) and organized by the American Association of Physics Teachers (AAPT) and the American Physical Society (Watkins, 1991). The conference participants identified several problems (termed "critical issues") faced by community colleges physics teachers and made recommendations to national organizations that might address those problems. But little action was taken on these recommendations, which were not prioritized and which were issued without an implementation plan.

Through its emphasis on professional networking (discussed in Chapters Two and Six of this monograph), the TYC21 project mobilized two-year college teachers themselves to study and address — from the ground up — critical issues in physics education. Most TYC21 regions studied issues that were important to them and, in many cases, took actions on the basis of those studies. The critical issues examined by the regions fall into four broad categories:

- Isolation
- Outcomes and outcomes assessment for introductory physics
- Science for all Americans
- Invigorating introductory physics courses

This chapter discusses each of these issues, as well as a fifth issue that has recently come to the fore – improving the mathematics and science preparation of future teachers.

Isolation

Faculty members in several TYC21 regions identified isolation as a critical issue. From their perspective, two forms of isolation threatened the viability of community college physics education. The first is the isolation of individual community college physics teachers from other community college physics teachers. The second is the isolation of the physics curriculum from the world of work and from the other disciplines. Both challenge community college physics teachers to reach out to each other and to connect with others within and outside of the academy.

Isolation from Colleagues

The isolation of individual faculty members from colleagues was highlighted at the 1989 "Critical Issues" conference (Tavel, 1991). This form of isolation is not surprising, given the large number of one-person physics departments at community colleges, especially in rural areas. But many physics teachers in metropolitan areas feel this isolation as well. As Nelson reports in Chapter Three of this monograph, the regional coordinators responsible for TYC21 activities in the San Francisco Bay Area and in the Kansas City metropolitan area reported high levels of faculty isolation; prior to the TYC21 project, there was no mechanism for faculty interchange in these areas, and the coordinators spent a great deal of time simply helping the teachers to get to know one another and share information on classroom practices.

TYC21's emphasis on personal networks was a direct response to this problem. The national and regional networks that have emerged during the course of the project addressed concerns expressed in many high-level reports. For example, *Physics at the Crossroads* (American Association of Physics Teachers, 1996) includes, among other recommendations, a call for "An easily accessible communications infrastructure that keeps all faculty members informed of the latest results in curriculum development, physics education research, and the latest examples of best practice in undergraduate physics teaching." The report urges the development of a system that "provides multiple mechanisms for faculty members to share their experiences and curricular materials." Hilborn, Howes and Stith (1997) also support the importance of good networking. "Our correspondents," they note, "report that many faculty remain disconnected from the concerns of (the) *Crossroads* [report]. It's not clear how to get their attention. ...If we are to have a significant change ...we must reach out..." Given the continued problem of isolation, the 1995 National Research Council (NRC) and National Science Foundation (NSF) convocation concluded that "Undergraduate education will not change in a permanent way unless there is a coordinated effort of many people. Change requires ongoing interaction among communities of people and institutions that will reinforce and drive reform" (National Research Council, 1996).

In addition to face-to-face meetings, TYC21 regions have attempted to network through newsletters, e-mail list serves and web pages. In most cases use of the latter two has been limited because, as O'Kuma and Enger note in Chapter Two, they are not by themselves adequate to foster the sense of community needed to sustain collegial work. Many other lessons about networking were learned during the course of the TYC21 project, and they are summarized in Chapters One and Six by Swanson and Dickinson, who outline seven traits of a successful network. A fundamental insight gained by the TYC21 participants, however, is that building a network takes time; indeed, the network building begun during the TYC21 project is still in progress. But given the critical importance of networking — long recognized by the physics community — it is vital that this work continue beyond the end of TYC21.

Isolation of Physics from the World of Work and from Other Disciplines

The second form of isolation has also been recognized in national forums. For example, the authors of the 1996 *Shaping the Future* report (Committee on the Review of Undergraduate Education, 1996) quote the summary of the 1995 NRC-NSF convocation on undergraduate education (National Research Council, 1996), which states that undergraduate education suffers from a "fragmentation of knowledge" that is "more appropriate to advanced research." The Convocation summary also emphasizes the need to connect physics to the world of work, noting that

> **The needs of the work force are changing. ...This dynamism in the labor market is putting a premium on students who have a broad knowledge of different subjects. ...Students educated with a narrow disciplinary focus and in solitary learning styles can have difficulties adjusting to such an environment (National Research Council, 1996).**

While many acknowledge the disconnect between physics education and the real world, Region 5 attacked it head on during the TYC21 project and has made a significant impact in Minnesota. Region 5 Coordinator Aaron Wenger and his colleague Ron Ulseth acknowledged the isolation of physics, recognizing that a physics curriculum that concentrates on educating physics majors is, in a real sense, the problem itself and not the solution. They turned their attention to rebuilding the physics program at their respective colleges by concentrating on "real-world" applications. For example, they restructured their physics curricula to emphasize the motion of real objects (not point particles), and when teaching concepts of electricity, they emphasized circuits rather than fields. (They refer to this as camouflage, noting that they "camouflage a lot of physics analysis within applications and systems closer to being real..." [Wenger, 1998].) Wenger and Ulseth also turned their attention to student recruitment, a task that they approached with the same fervor used by coaches to recruit athletes. They visited area high schools and talked about engineering with students, sometimes taking them to universities that accept engineering transfer students. They also developed seamless transfer agreements and viable internships for students with local industries.

As a consequence, the engineering programs at their two colleges have flourished, growing from a combined enrollment of 5 students in 1990 to 70 freshmen and 50 sophomores in 1998. Students are successfully transferring to universities and becoming engineers. Wenger explains that, "Every once in a while we even have a physics major!" (Wenger, 1998). In addition, the NSF has taken notice, awarding Wenger and Ulseth a grant to develop the use of interactive video in teaching engineering to students at remote sites. The NSF has also funded their effort to involve high school and community college physics teachers in a collaborative project aimed at developing learning modules in open-lab formats.

Outcomes and Outcomes Assessment

Outcomes-based education has become increasingly important as legislators demand evidence of student learning and accrediting bodies judge colleges on the basis of their impact on students (and not simply on the basis of such attributes as the size of the library or the credentials of the faculty). Yet it is not a simple process to specify desired outcomes for a class or a program, develop valid assessment tools, and interpret assessment results in ways that lead to meaningful improvements for students. This is especially true for faculty members whose training is in an academic discipline (in this case, physics) and not in educational measurement. Nonetheless, we must continue to move away from anecdotal evidence when judging instructional effects on students. Unless we can state our objectives and develop assessments that yield valid and reliable measures of student learning according to those objectives, we have no real way of knowing if our instruction has been successful.

Yet the faculty can rise to the occasion when given the opportunity to work together in the type of networks emphasized by TYC21. Faculty members in two TYC21 regions (Regions 3 and 9) cooperated to produce a scholarly report that can be used by teachers in introductory physics classes to specify objectives and assess student learning accordingly. They developed appropriate assessment tools and are in the process of sharing them with colleagues through workshops and papers. Through their efforts, they have demonstrated the viability of a successful network and have shown that meaningful and scholarly work can be accomplished when community college faculty members have the opportunity to communicate and cooperate.

Science for all Americans

The need to make physics accessible to all students, not just to physics majors, has long been recognized. It was a key emphasis of the 1989 Critical Issues conference

(Watkins, 1991), and it was a top concern within many TYC21 regions. Faculty members within many regions discussed "conceptual physics" courses and how they should be taught. Others considered how technology could be used as a teaching aid, while still others examined best practices in teaching about technology. All shared the conviction that while not everyone wants to be a physicist, everyone is capable of understanding basic concepts in physics. In addition, everyone needs to know how to use technology; they also need to understand what technology can do and what it can't do. As Lane (1996, p. 188) observed,

> **All scholarly fields...suffer from their separation from the public, although in the case of science, the separation may be more extreme. And yet science and the technology it spawns pervade the very structure of everyone's life...All scientists should help educate the public.**

Several regions devoted considerable attention to this problem. Examples include the following:

- Region 13 dedicated its time to discussions of conceptual physics courses. The region produced a white paper (Warren, 1998) recommending that AAPT's Committee on Physics in the Two-Year College (CPTYC) organize sessions on conceptual physics and establish a nationwide project to examine conceptual physics courses at community colleges and to promote curriculum development, especially for technical programs.

- Region 15 has started work on a unique approach to serving the broader physics community. They have sought funding for a program called PANIC (Physics Answers In Cyberspace). The goal is to produce an Internet physics department, enabling students in small community colleges to query professors at other institutions and allowing professors at different institutions to remain in contact with each other. The idea encompasses virtual office hours as well as class collaborations. The authors of this proposal, Tony Zito and David Emigh, are committed to this project and to its success.

- Region 14 has focused on college outreach to high schools, considering such efforts as workshops for teachers, loaning laboratory equipment to high schools, convening meetings of high school and college physics teachers, or hosting on-campus "science and technology days" for high school students. These initiatives were in place at some colleges before TYC21, often in the form of tech-prep programs or school-to-work initiatives. But the regional meetings have helped disseminate ideas for outreach to high schools among a wide group of community college physics teachers. The intent, ultimately, is to bridge the gap between high school and college while at the same time influencing students' attitudes about science.

Invigorating Introductory Physics Courses

Strengthening introductory physics courses, an issue that also emerged as a key concern of TYC21 participants, is in some ways related to the problem of the isolation of physics from the rest of the curriculum. Both imply a need to enhance the learning of those who enroll in physics courses and to increase the number of students who enroll in those courses in the first place. But while physics teachers examining the problem of curricular isolation sought to make connections with vocational programs, high schools, and universities, those focusing on introductory physics courses emphasized the development of more effective pedagogical strategies. They employed their networks to identify successful models of active learning and to study ways of implementing them in community college physics classes. This study of pedagogy is an important professional obligation. As the authors of *Shaping the Future* conclude, all faculty members in science, mathematics, and technology must "be familiar with and use the results of professional scholarship on learning and teaching" (Committee on the Review of Undergraduate Education, 1996).

The question of *how* to teach goes hand-in-hand with the question of *what* to teach. During the course of TYC21 it became apparent that the problem of determining what topics to include in introductory physics classes is more realistically a problem of which topics to leave out. The "less-is-more" philosophy applies here. So too does collaborative study of pedagogy. As a white paper for Region 11 suggests, "we cannot agree on what needs to be done, but we can become aware of the research and can then have dynamic discussions on methods and topics" (Yazdi, 1998). If we adequately assess the results of changes made in classroom instruction, we will have the necessary data to support our ideas of what should be included in our courses and what should not. Such data will also provide a feedback mechanism for further efforts to enhance student learning. Again, it comes down to networking opportunities that make us aware what is occurring in other colleges.

Another issue that indirectly affects the teaching and learning process is lecture/lab parity (that is, the inclusion of laboratory hours in calculations of a faculty member's workload). Faculty members in Region 6 studied the issue of lecture/lab parity, noting that if colleges desire active learning for students, then it makes sense that laboratories, which are the ultimate active learning settings, need to be recognized as substantive parts of the teaching load (Dowdy, 1998).

Improving the Math and Science Background of Future Teachers

None of the TYC21 regions directly addressed the issue of teacher preparation. Yet during the course of the TYC21 project, the importance of enhancing the science preparation of future teachers became clear in a National Science Foundation report (Bragg, 1998) noting that approximately 40% of America's teachers complete some of their science and mathematics courses at two-year colleges. The report also noted that many elementary school teachers complete their only mathematics and science course work at a two-year college. Given these figures, the science preparation of teachers is now regarded as one of the top five critical issues facing two-year colleges.

Consequently, several community college physics teachers have begun working on this issue. It is directly linked to the issue making science accessible to all Americans. As the authors of *Shaping the Future* (Committee for the Review of Undergraduate Education, 1996) note

> **A large percentage of prospective K-12 teachers begin their education in two-year colleges. These institutions with their clear commitment to teaching and with so many prospective teachers as students must be more significant partners in the system of teacher preparation. ...It should be kept in mind also that many prospective teachers prepared in the undergraduate level eventually will become principals and superintendents. ...Their attitude toward science, math and technology...will depend in part on the kind of experience they had in SMET as undergraduates.**

The most obvious way to have a positive effect on the training of future teachers is by developing courses that are relevant to their goals. It is imperative that we develop courses that show prospective teachers the elements of science. In that context we can act as role models and provide a significant mentoring function for them. Teacher preparation is clearly an issue that the teacher networks formed during the TYC21 project should continue to address.

Conclusion and Recommendations

The critical issues discussed above require the continued attention of community college physics teachers. But none of the work on these issues will be sustained without networking, and networking will not succeed without regular face-to-face meetings. Furthermore, there is a strong likelihood that without national leadership, several regions will not continue to function as viable groups. These regions may fall back into the same problem of isolation that was present before the start of TYC21. But there will be one key difference: Now that the faculty has experienced the benefits of networking, its members will return to isolation only with a great sense of frustration.

In light of the many critical issues facing the two-year college physics community, proactive steps should be taken to sustain the networks built during the course of the TYC21 project. The four recommendations outlined below are made with this long-term goal in mind.

- **RECOMMENDATION ONE:** National meetings of such organizations as the American Association of Physics Teachers should include sessions or other meeting components that are dedicated to the issues facing community college physics teachers. A two-year college presence on the national scene is vital to the continuation of the good work that has begun. One meeting a year would probably be sufficient to keep the national agenda on course. Coupled with this recommendation is the need to make members of the two-year college physics community aware of the importance of reporting their work to the broader, national community.

- **RECOMMENDATION TWO:** The two-year college physics committee of the American Association of Physics Teachers should encourage interested individuals to organize themselves into a group dedicated to the continuing study of two-year college physics education. Funding for this group should be sought, if necessary.

- **RECOMMENDATION THREE:** A commission should be formed to (a) study the validity of figures used to measure student retention, and (b) outline steps that can be taken to increase retention generally as well as the fraction of two-year college students who take physics courses. (The issue of retention was not directly addressed by TYC21 participants, yet it has an important bearing on teaching and learning. This is dramatically illustrated in a Washington Post op-ed piece written by Clifford Adelman (1997), who noted that only 23% of those who attend community colleges actually earn an associate's degree. These low retention figures are often viewed by administrators and the general public a failing on the part of the faculty and are often used to justify the hiring of more part-time instructors. But as Adelman stresses, this heavy dependency on part-time instructors will have to cease as more and more students work toward a degree in accordance with the president's vision of making K-14 education universal for all Americans. In the author's words, community colleges are "in a position to turn the whole (educational) system around – if slowly. They have a weighty set of challenges on their table" (Adelman, 1997, p. A19).

- **RECOMMENDATION FOUR:** The AAPT's Committee on Physics in Two-Year Colleges should take a proactive role in addressing the disparity between lecture and lab hours when determining faculty work loads.

A national voice is the key to effective change. We possess strength of numbers and long experience teaching physics to a diverse student population. We need to continue to use this expertise to develop our voice as an important player in the science education community.

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CHAPTER 6

The TYC21 Networking Model: The Experience of Two-Year College Physics Teachers

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TYC21 — Two-Year Colleges in the Twenty-First Century — had the overarching goal of joining community college physics teachers in national and personai networks that would enhance classroom teaching and strengthen the community college voice in debates about physics education. Work on developing these networks began in the early stages of the project through the establishment of fifteen regions across the country, each with a regional regional coordinator who worked with his or her colleagues to develop a sustainable local network from the ground up. At the national level, TYC21 project leaders and steering committee members had the responsibility of connecting the regional networks into a national network that would bring a greater community college presence into the larger physics community.

As work on the project proceeded, a model of professional networking emerged. This chapter describes the events that led to its development and outlines its seven components. The chapter concludes with observations about the current status of the TYC21 network structure and about the steps that need to be taken to sustain that network in the future. The intent is to summarize the TYC21 experience in ways that will help other community college faculty members develop similar networks within their own academic disciplines.

Background

Those who began the TYC21 project realized that a networking model for two-year college physics teachers should make it possible for individuals to form personal and professional links with colleagues at other institutions and with the larger disciplinary community. But before establishing such a network, consensus had to be reached on the salient features of a successful network. Hence there was a great deal of discussion about what the regional and national networks might entail. Most regional meetings devoted considerable time to this subject, and some regions even developed papers on the topic. The steering committee also debated the concept of networking, and sessions at the annual national conferences allowed TYC21 participants to consider networking from different viewpoints.

The evolution of TYC21 regional and national networks can be tracked by using the three national meetings as benchmarks. National Meeting One (NMI), "Realizing a Vision," was held in August 1996 at College Park, Maryland. National Meeting Two (NM2), "Focusing on Action" was held in August 1997 at Denver, Colorado. National Meeting Three (NM3), "Partners in Scholarship" was held in August 1998 at Nebraska City, Nebraska. While Chapter Four details the history and purpose of those national meetings, the intent here is to note how they contributed to our understanding of what successful networking entails.

National Meeting 1

At NM1, regional teams involving a total of 60 community college physics teachers met for three days with members of the national steering committee, staff members from the American Association of Physics Teachers (AAPT), and invited outside speakers. This was the first opportunity to broaden the national network through the involvement of regional teams. The meeting was marked by a significant amount of "outside" expertise and no small amount of discomfort on the part of attendees as they grappled with the problem of how to build networks and engage the collective energy of network members in identifying and addressing meaningful national issues. While no formal evaluation of the networks was attempted at this time, informal indications of network evolution were gleaned from meeting evaluations and from the observations of steering committee members. The feeling was that TYC21 participants had been energized and were committed. But there was a significant amount of uncertainty as to how the process would unfold and how the fledgling networks would be able to function effectively. We learned that is one thing to understand the importance of networking, quite another to make networking possible.

National Meeting 2

After another round of fall and spring regional meetings, regional teams gathered in Denver, CO, in August 1997 at National Meeting 2. Regional teams reported on their efforts to act on "critical issues" that they had identified and developed. During NM2, regional coordinators also filled out a written survey about the status of the networks in their regions. The survey asked the coordinators about the rate at which community college physics teachers in their regions participated in TYC21activities, about the ways they contacted those teachers, and about the viability of the networks that had been developed. The Coordinators estimated that they had contacted 91% of the community college physics teachers in their regions, that 25% of the total number of the physics teachers in their regions had attended a TYC21 activity, and that 13% could be considered active TYC21 participants. These findings led to the general conclusion that a network of the type developed during the TYC21 project can expect a 20% participation rate. Open-ended comments (along with other discussions we have been involved in) suggest that an additional 20% will be recalcitrant and not interested in any participation, while the majority (about 60%) will be interested but passive.

This low participation rate notwithstanding, written survey responses indicated a great deal of enthusiasm for the project and a widespread recognition of the importance of leadership and resource support. In addition, several regional coordinators indicated that the most important factor in the formation of a network is a focus on meaningful issues that will engage the energies of network members. But this observation was coupled with a recurring uncertainty about how the TYC21 members could actually address and solve difficult problems facing the national physics community.

National Meeting 3

At the end of National Meeting 2, the steering committee recognized the significant growth within the regional leadership. Thus, the program for National Meeting 3 was turned over to the regions. As a result, NM3 became the most successful of the national meetings, demonstrating the robust nature of the newly established networks.

During NM3, regional coordinators were interviewed about their perceptions of the networking process. Their responses were realistic and sobering. Steering committee member Tom O'Kuma summarized what was learned. His abridged observations are as follows:

> **Concerning the networks, we have learned that there are a number of two-year-college (TYC) teachers who want to be involved in these kinds of activities. TYC21 has found a lot of these [individuals]. We hope the regional networks are viable enough to continue. You need a critical mass of people with common interests. The model for networking used to be based on mentoring – senior faculty bringing the new members into the network. That kind of relationship does not typically exist in the TYCs. TYC21 was able to reach those with the interest to be involved but where there was no mechanism.**
>
> **TYC21 was able to build on the synergism of programs that were ongoing and were developing the network. Examples are the TYC workshops and national and state supported programs such as PEPTYC and North Carolina's Curriculum Improvement Project. The political climate and growing recognition of the importance of TYCs in the educational community were also positive factors. In virtually every region, a lot of TYC teachers were actively involved but their contributions as a group were not broadly known. TYC21 has provided the opportunity for that information to be more widely known and recognized. ...The contributions are important to the broader community.**

> **How to develop a network: Have a venue, a reason for participating. You must have a place to come. You need resources to support the activities. In metropolitan areas especially, distance is a major factor. The people must feel they have benefited from the activity. You must have leadership. Leaders play the role of mentors for new members.**

Subsequently, during the fall of 1998, TYC21 steering committee members analyzed the networking process in each of the regions. While each region had its own peculiar history, geography, experiences, successes and challenges, some consistent themes emerged. These themes, described in more detail in Chapter 1 (pp. 13-22), emphasize the need to provide training, facilitate personal interaction, invite member participation, provide needed fiscal support, encourage attention to issues that uniquely affect community colleges, and form networks within geographic regions that make sense to those who are involved. Each is important to creating a successful network.

The TYC21 Networking Model

As a result of these discussions about networking, a common core of seven traits emerged. These traits, outlined below, do not encompass all that is necessary for the formation of disciplinary networks among community college faculty members. But they do constitute our consensus about what has been most important to the development of the national and regional networks that were central to the TYC21 project.

1. **Facilitate professional communications.** The typical two-year college physics teacher works in isolation. He or she seldom participates in professional physics meetings and activities. Often he or she is the only physics instructor at the college. A network involving these instructors needs to provide mechanisms for sharing insights about the ways they approach their work. This needs to be done at many levels — from the informal to the formal. The network also needs to serve many types of instructors — from the isolated individual who is reluctant to share ideas, to the experienced veteran who has already plugged into national professional organizations.

2. **Encourage and support personal interaction and collaboration among colleagues.** If faculty members are to invest themselves energetically in the network, it is important that the network address their personal as well as professional needs. Most instructors need and want to build friendships; they want to be part of a special community. Networks must not only to allow this – they must actively encourage it. Because many physics faculty members are often shy and somewhat withdrawn, networking activities must help them make connections with others.

3. **Provide mentoring for potential new leaders.** Up until the time of this project, the two-year college physics community had too few leaders. These leaders knew the system and could get things done, but they were getting close to retirement. There was a critical need, therefore, to develop the next generation of leaders. This is important to the continued viability of any professional group. A network of community college teachers need to connect future leaders with mentors who can teach the necessary leadership skills and ease younger colleagues into leadership positions without overwhelming them with responsibilities.

4. **Respond to national issues.** The teaching of physics at community colleges does not take place in a vacuum. It is affected by the actions of such agencies as the National Science Foundation or the Department of Education. Professional organizations, such as the American Association of Physics Teachers or the National Association of Science Teachers, also have an impact, as do the actions of local college governing boards. A professional network should provide physics teachers with a collective mechanism for influencing the decisions of these agencies and responding to the decisions once they are made.

5. **Help members keep abreast of developments in physics education research, and its implications on teaching.** The emerging field of physics education research has had a great impact on teaching in the two-year colleges. This research has led to important insights about how students learn, about the misconceptions students have about physics, and about the ways teachers can help more students understand physics concepts. The network needs to keep instructors informed of these developments.

6. **Help teachers evaluate and consider different teaching methods by sharing experiences.** Community college physics instructors are very concerned about what teaching methods best facilitate student learning. But because there is no one "best" way, each teacher has to experiment with different methods to find the one that is most suited for his or her students. This does not need to be done in isolation. A great deal of time and effort can be saved by learning what works and doesn't work from other instructors and students. The network should facilitate this learning.

7. **Become a viable, vigorous, and self-sustaining force for improving physics teaching.** In its first years, the network was developed and nurtured with funding from the National Science Foundation. It remains to be seen if the network has become important enough within the two-year college physics community to become self-sustaining and viable now that the funding has ceased. Any network must be developed with this long-term viability in mind. TYC21 will be a success if in five or ten years its national and regional networks continue to thrive.

Next Steps

As we noted in Chapter One, the third National meeting ended on an almost euphoric note. TYC21 had involved approximately 20% of the nation's community college physics teachers, and a majority was watching with interest. Yet there remained some disappointment about the limited progress the networks had been able to make on specific issues. The project also ended with some concern about its continued viability after cessation of funding.

In April 1999, the project's leaders hosted "A Vision for Tomorrow" meeting. The goals of the meeting were to identify resources to enhance networking, define the role of the national network, and solidify the national network by extending activities across regional boundaries. The meeting facilitated the transition of the organization from one that was supported by outside funding to one that continued on a self-sustaining basis. The result was an action plan for TYC21's future development. Central to this plan is TYC21's continued association with the AAPT. Indeed, a key recommendation is that the TYC21 regions should cooperate with and take advantage of the existing structure of the AAPT sections to maintain regular meetings and communications. Through its work with the AAPT, TYC21 can continue to maintain the national identity its has forged for community colleges within the larger physics community. Other steps in the action plan include the following:

1. **Each region should establish a mechanism for succession of leadership.** This will ensure that necessary leadership roles continue to be carried out. These include organizing meetings, facilitating communication among members, maintaining contacts with other educational communities, maintaining group records and histories, and ensuring the ongoing viability of the network.

2. **Each of the TYC21 regions should develop a written plan for the future.** These plans do not need to be long, but they must outline how the region will continue functioning in the future. The plans should include information on:

    a. when and how often the group will meet;
    b. how the group will maintain its identity;
    c. what future meetings will entail;
    d. who will organize meetings and maintain communications;
    e. how the meeting (and travel to the meeting, if necessary) will be supported; and
    f. what projects the region members will work on and how those projects will be funded

3. **The AAPT should develop an organizational structure that facilitates networking among constituency groups, such as community college teachers.** Perhaps one of the associate executive officers of the national AAPT organization should be assigned as the TYC21 liaison. In addition, the role of the TYC21 representative to the AAPT executive board should be reevaluated, as should the role of the members of the TYC21 steering committee. The organizational structure should provide for long-term viability by performing such functions as:

    a. knowing what the regions are doing and encouraging leadership within those regions;
    b. actively encouraging proposals for the support of worthy projects;
    c. helping with the TYC newsletter and other mechanisms for providing publicity and visibility for the network.

4. **The AAPT executive board should allocate funds in the RAPT budget to support the TYC21 network, subsidizing at least one TYC21 newsletter per year and providing necessary administrative support. In addition, the role and membership of this committee should be restructured to enable it to provide meaningful leadership for the TYC21 network.** (Parenthetically, we expect that the same kind of restructuring would be necessary for committees dealing with other constituencies such as high school and university teachers.) The TYC21 representative on the executive board should play an active and meaningful role with the committee and be provided with the resources and authority needed to take actions that ensure network viability.

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CHAPTER 7

Faculty Isolation: A TYC21 White Paper

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As previous chapters have indicated, the TYC21 project sought to overcome the isolation in which community college physics teachers work. The ultimate intent was to enhance teaching and learning. Though the individual efforts of community college faculty members are laudable, students are served best to the extent that their teachers learn from colleagues and participate — at the regional and national levels — in professional associations related to their academic disciplines.

This chapter reviews what is known about faculty isolation and describes what we in the TYC21 project learned about combating it. We begin by outlining the historical events that led to the initiation of TYC21 and then review what the literature has had to say about the extent and effects of isolation. After describing the steps taken during the TYC21 project to break down the barriers that reinforce this isolation, we conclude with a set of recommendations — aimed at individuals, colleges, and the profession at large — that we feel will help two-year college physics teachers form an even more cohesive community.

Background

By the time the TYC21 project officially began in late 1994, the vital role played by community colleges in physics education had long been recognized, as had the need to combat the isolation impeding the work of community college physics teachers. In 1989, the American Association of Physics Teachers (AAPT) and the National Science Foundation (NSF) jointly funded a topical conference entitled "Critical Issues In Two-Year College Physics and Astronomy-1990 and Beyond." Gerald Wheeler, then President of AAPT, opened the conference by noting the urgent need to include more community college teachers in the work of the association: "For this conference one common point is obvious to me: the two-year college physics programs are invisible to most of the physics community. Yet, if one makes a quick study of the numbers, it becomes obvious that the two-year college is taking on an increasingly important role in educating our public. All of us need to exchange ideas and know about one another's work." (Wheeler, 1990, p. 1).

The idea for TYC21 was subsequently conceived and submitted to the AAPT board in 1993. This initiative, led by two-year college members of the AAPT, was designed to take the first step in addressing the isolation of community college physics teachers (and their attendant lack of visibility) by creating a personal and self-sustaining network of colleagues, beginning at the local level. The originators of this reform effort believed that if faculty isolation could indeed be overcome, the project had the potential of adding a strong and fresh new voice to national discussions of introductory physics education. Robert Beck Clark (1994, p. 3) put it well in his keynote address to participants at the 1994 national meeting at the University of Notre Dame[2]:

> ***The key and essential role of two-year colleges in physics today in the United States is one of the best kept secrets in the physics community and the great impact of two-year colleges to the teaching of introductory physics is not fully appreciated!***
>
> **Hence, there is a critical need for networks among two-year college physics faculty members. The isolation of many who teach in two-year colleges is often far greater than that of their colleagues in four year [colleges] or secondary schools. This isolation is exacerbated by small physics faculties, heavy teaching loads, and administrators with little sympathy for the critical need for continuing professional development of their faculty members. The high percentage of part-time faculty members who traditionally have had neither the time nor the disposition to be involved in professional development programs adds to the isolation.**

Upon the announcement of funding in 1995 from the National Science Foundation's Division of Undergraduate Education, the AAPT formally launched the TYC21 program. The association's newsletter, *ANNOUNCER*, sought to engage members of the two-year college community with "An Invitation to Involvement" featured in each issue from 1995 through 2000. The program description published in the *ANNOUNCER* reflects three themes that emerged as the project sought ways to combat isolation: leadership, communication and scholarship.

> **TYC21 will improve the quality of physics education in the United States by developing and enhancing communication among two-year college physics faculty. The primary goals of the program are accomplished through a series of regional and national meetings, as well as newsletters and electronic communication. These meetings and communications provide a forum for sharing new educational curriculum models and teaching techniques within the physics education community and promoting the establishment of partnerships with higher education and with industry and government. ("An Invitation To Involvement of Two-Year College Teachers", 1999)**

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[2] See Chapter 4 for a review of the TYC21 national meetings.

During its four-year existence, the project has successfully addressed the critical issue of isolation within the two-year college community. Fourteen of the 15 regions continue to organize and host local activities, and TYC21 leaders from 14 regions participated in the 1999 Two-Year College National Conference held in tandem with the Summer AAPT Meeting in San Antonio, Texas. The local meetings have involved more than 500 physics faculty members from two-year colleges, and the AAPT membership from two-year colleges has increased by about 200 since the early 1990's. The acronym, TYC21, is referenced in many AAPT Section reports and letters of congratulations for success have been received from the professional organizations of American Association of Community Colleges, the United States Department of Education, the American Council on Education, the American Institute of Physics, and the League for Innovation in the Community College. Indeed, TYC21 has accomplished the goals of the Project Vision framed and drafted by the nine-member project steering committee during the spring of 1995:

> **The *Two-Year College in the Twenty-First Century: Breaking Down Barriers (TYC21)* will improve the quality of physics education in the United States by developing and enhancing communication among two-year college physics faculty.**
>
> **The project will motivate involvement among two-year college physics faculty members by creating opportunities to network and share ideas on a professional and personal level. TYC21 will increase opportunities for outreach and community partnerships, validate personal teaching experiences, and empower these two-year college teaching faculty within the whole physics community.**
>
> **By developing a strong, vigorous, and valuable network, the TYC21 project will become self-sustaining. Leaders will emerge and relationships will form that promote continuing opportunities for networking, communication, and dissemination of information. Through regional and national collaborative efforts, two-year college faculty members will become more visible within the physics community and the isolation experienced by many two-year college physics faculty members will be greatly reduced ("TYC21 Vision Statement," 1995).**

The Meaning of Isolation

The leaders of TYC21 launched the project with two forms of isolation in mind. One is the two-year college's lack of visibility in the larger physics community. The second is the lack of active communication among two-year college physics faculty members themselves. Awareness of both has been enhanced by a growing literature on isolation, by calls within the National Science Foundation for greater networking among two-year college physics teachers, and by a groundbreaking 1996 survey of community college physics teachers that was conducted by the American Institute of Physics. All have contributed to our understanding of the extent to which isolation is a problem and of the ways two-year college teachers perceive this isolation and its effect on teaching and learning within introductory physics classrooms.

What the Literature has to Say

The literature strongly indicates that community college physics teachers are not alone in their sense of isolation. It is a problem felt throughout education. Alfred and Linder (1992) describe the isolation between faculty members and administrators generally, groups that often have different goals. Kimmel, Kerr and O'Shea (1988) offer suggestions for addressing the isolation felt by in-service teachers at the pre-college level. Massey, Wilger, and Colbeck (1994, p 12) state that isolation is a characteristic of most college teachers: "Overwhelmingly," they note, "Our respondents identified a central reality of academic life: faculty work alone. Even junior faculty work in relative isolation, receiving little guidance from departmental colleagues or even chairs." They go on to attribute this isolation to the departmental structure of colleges and universities:

> **Three key features of academic departments constrain faculty in their ability to work together on teaching. First, fragmented communication patterns isolate individual faculty members and prevent them from interacting around issues of undergraduate education. Second, tight resources limit opportunities and strain faculty relationships. Third, prevailing methods of evaluation and reward undermine attempts to create an environment more conducive to faculty interaction.**

But the small number of studies addressing community college teachers specifically suggests that those who work in community colleges face special challenges. For example, Block (1991, p. 20) argues that the lack of discipline-based research at the community college has contributed to the isolation many faculty experience:

> **Community college faculty members, especially in career and technical programs, often do not have the support they need to keep abreast of their profession. Many feel isolated-out of touch with colleagues in their fields. We find it especially disturbing that 63 percent of the community college faculty in a national survey rated the intellectual environment at their institution as 'fair' or 'poor'. In a climate such as this, teaching effectiveness is diminished and the potential for excellence is lost.**

He goes on to note that faculty members at two-year colleges normally do not engage in professional activities beyond the preparation of classes. The single focus on teaching with little inclusion of scholarship does explain the early success of the community college, Block concedes, but with time, this environment has produced faculty members who have "no professional lives apart from their teaching" (Block, 1991, p. 20).

Pederson (1989, 5) concurs and adds the following:

> **The failure of most community colleges to embrace an institutional value system which supports discipline-based research has cut the institution off from the dynamic quality of the disciplines and the larger intellectual culture. The effect of this isolation on community college faculty has been profound. More importantly [this failure] has created two separate and unequal classes of undergraduate student.**

Educational leaders have grown increasingly aware of this isolation. At a 1989 National Science Foundation workshop on science, engineering, and mathematics education in two-year colleges, Parilla (1989, p. 3), then president of Montgomery College (MD), noted that "There are limited professional development activities, heavy teaching loads, and a lack of interaction with colleagues to engender collegiality. In addition, there is a traditional lack of scholarly tradition in two-year colleges, and a perception that one cannot embrace both pedagogy and research."

Similarly, Judith Tavel of Dutchess Community College (NY) has observed the prevalence of isolation in her faculty surveys:

> **I have been told that isolation was the most critical issue for faculty at two-year colleges and considering this data I certainly can see why. As one respondent to the questionnaire put it, "I am solely responsible for all of the physics taught and learned. There isn't even anyone within 100 miles that is remotely interested in discussing physics with me" (Tavel, 1991b, p. 34).**

Tavel (1991a) further discusses the root causes of this isolation, suggesting that the lack of sabbaticals and professional development is a major contributor. She also points out the large teaching load and heavy departmental responsibilities that make it difficult for faculty members to carve out time for collegial discussions with colleagues, either on campus or off. (Of the physics teachers responding to her first survey, 62% worked in physics departments staffed by one full-timer or by no full-timers at all.) And she concludes that community college physics teachers are isolated from colleagues on campus as well as from physics colleagues at other institutions. Reflecting in the mid-1990s on the two surveys she had conducted, Tavel (1995, p. 87) noted that while most of her respondents worked with colleagues who taught physics on a part-time basis, they reported that "it really does not help having a part-timer (or worse, multiple part-timers) [as colleagues] because part-time faculty rarely have a commitment to either the school in general or physics in particular." When asked "What faculty like least," the respondents stated workload (100%), isolation (78%), poor image (52%) and poor pay (43%).

The National Science Foundation Workshops

Working in parallel with the AAPT at the beginning of the 1990s, the National Science Foundation (NSF) sponsored a series of workshops addressing the science, mathematics, engineering and technology education at two-year colleges. The topic of isolation or related issues was discussed at each of these workshops, pointing out the need physics teachers had for increased networking opportunities. During the first workshop in June 1989, attendees observed that "The heavy teaching loads of the two-year college faculty members make it difficult for them to pursue the few, existing opportunities for professional growth. In addition, these faculty tend to be isolated from other colleagues in their disciplines and many have not kept up-to-date in their fields" (Parilla, 1989, p. 3). At the second workshop, held in May 1991, the participants made recommendations for curricular reform, program improvement, and active partnerships with industry and local schools. They also highlighted "a critical need to provide professional development and renewal opportunities for faculty" (Ewen, Mertes, & Shen, 1991, p. 3).

Dr. James Stith's plenary address at the third workshop zeroed in on the problem of isolation. He noted that "A concern raised in several workshop groups has been the sense of isolation experienced by many faculty at two-year colleges." He went on to say that, "A strong recommendation from several groups is that professional societies must establish networks to help eliminate that feeling of isolation" (Forman & Stith, 1992, p. 10).

The fourth NSF workshop produced a better characterization of the isolation experienced by many in this community. The proceedings (Cunniff, Hieggelke, & Smith, 1993, p. 2) note the following:

> **The distinctive culture in many two-year colleges, and in some four-year colleges as well, poses special challenges. In some institutions, there may be little encouragement for scholarship beyond that associated with classroom teaching. All these factors, limited time outside the classroom, limited opportunity for staying current in one's field, and limited support of ongoing scholarship, can serve to isolate many two-year college faculty from their disciplinary moorings, especially in rapidly changing fields. Indeed, many studies indicate that these faculty have a strong sense of discipline isolation.**

The American Institute of Physics Survey

At about the same time the TYC2I project began, the American Institute of Physics started its planning for the first national survey of two-year college physics in the United States. By 1996, the AIP had prepared and mailed a questionnaire to every two-year college in the country. The findings do not directly address the matter of isolation. But they nonetheless offer supporting evidence.

For example, the study report (Neuschatz, Blake, Friesner, & McFarling, 1998) describes two-year college physics education as: "the most neglected segment of the physics teaching enterprise, a view corroborated in previous research" (p. 20). It goes on to note that "While physics may be arguably portrayed as one of the more carefully studied — and self-studied — of the disciplines, investigations into physics education at the two year level have been few and far between." The report further indicates that "...a search of existing resources turned up no available listing of physics faculty that even came close to completeness" (p. 4). The probable reason, the report authors speculate, lies in the fact that "physics...tends to be so small a part of the two year scene...[and] gets lost in the shuffle, rarely meriting any special attention or mention" (p. 3). Furthermore, "Many university-based physicists regard two-year instruction as lying outside the 'mainstream' of physics education. Perhaps more than most disciplines, physics has been dominated by the agendas and views of those involved in graduate studies, especially at the doctoral level" (p. 2).

The survey provided data substantiating the important role played by the two-year college community in both college education generally and introductory physics in particular. It noted that "just under one million freshmen" enter two-year colleges each year and that approximately 25% of college students who take introductory physics do so at a community college. But the study report also pointed out that the physics teachers at these institutions work in isolation.

> **One area of major concern for those involved with two-year college physics programs is what is perceived as the relative isolation and lack of professional involvement among the faculty. A mentioned earlier, nearly half of all campuses have only one member teaching physics. Additionally, faculty may teach in more remote areas of the country, with few opportunities to engage in professional activities, particularly if their department does not provide much funding for such activities (Neuschatz, et al., 1998, p. 26).**

Other observations made in the AIP report include the following:

- Physics teachers at community colleges have, on average, a relatively long tenure with a single institution. The report notes that "Full-time, permanent faculty had taught at the two-year college level for a median of 15 years, 13 of those at their current college. ...This high level of career stability was found among faculty at all career stages, across all levels of experience, but was most pronounced for those with more than 20 years of experience, who had taught a median of 26 years, 25 of them at the same institution. Our survey also found an unusually high percentage of full-time faculty have spent their entire physics careers teaching at the same college" (Neuschatz, et al., 1998, p. 27).

- In contrast to colleagues who teach physics at four-year colleges, physics teachers at community colleges work in conditions that make it relatively difficult to network with colleagues. "Among...[the] findings are the pattern of two-year college physics faculty having larger course loads, spending a greater percentage of their time on teaching related activities, receiving lower compensation, and having access to fewer support services and available resources" (Neuschatz, et al., 1998, p. 20) These findings mirror Tavel's observations (Tavel, 1991a, 1991b, 1995).

- Although community college faculty members often belong to national physics education organizations, and although they experiment with instructional innovations, they make few contributions to the publications of those associations. This is to be expected, given their high teaching loads. But as a consequence, they remain an invisible component of the profession; their potential contributions to the advancement of classroom teaching remain out of sight from colleagues who teach in the schools and in four-year colleges.

These and other observations led the study authors to conclude as follows:

> **At the center of their ranks was a strong core of committed, professionally active teachers, whose responses and comments reflected a deep involvement in their craft, a familiarity with the latest instructional innovation, and a familiarity with and empathy towards their students, like themselves, often regarded as outside the academic "mainstream". ...However, juxtaposed against the highly integrated group was an even larger segment of the community that appeared quite isolated (sometimes voluntarily so), with minimal interaction with other members of the two-year college teaching community and little familiarity with new teaching approaches and resources (Neuschatz, et al., 1998, p. 44).**

Breaking the Barriers

The question that the TYC21 leaders faced, and which the two-year college community will continue to face, is how to reach faculty members and convince them to become involved. Norrell and Ingoldsby (1991) propose three strategies to overcoming academic isolation:

1. **develop relationships with those who are equally isolated;**
2. **pool resources and provide support; and**
3. **take advantage of the unique research opportunities the small college environment provides.**

However, each of these strategies implies an isolated person who seeks to become "un-isolated." TYC21 took a somewhat different approach. The project sought to involve community college faculty members in conversations about student learning while at the same time not forming an organization apart and separate from organizations that involve other physics teachers and physicists. To accomplish this, the leaders had to help community college physics teachers realize their individual need to be a member of the TYC21 network and then — through leadership, communication and scholarship — engage these teachers in breaking down the barriers that stand between them and their colleagues.

...By Realizing A Need

The creation of TYC21 involved a handful of physics faculty members from the two-year college, joined by colleagues from professional organizations and four-year institutions, who sought to develop a way for "all of us to exchange ideas and know about one another's work" (Wheeler, 1991, p. 1). However, it was clear to the project directors in 1994 that the success of the networking project would depend on what the physics teachers themselves did at the local level. If regional networks were going to be established, and if they were going to become self-sustaining, the awareness of academic isolation and its impact on the classroom would have to emerge at the local level as well as at the national level.

As the project developed, reports from the fifteen regional leaders supplied anecdotal evidence that TYC21 activities were awakening an awareness of isolation and its impact on classroom teaching. Proceedings from the regional meetings held during the fall of 1995 *(Proceedings of Regional Meetings, Fall 1995)* included such observations as:

- "[It] remains difficult to get TYC physics teachers away from their campuses for more than half day periods."

- "I felt the impact of the isolation issue was exhibited by the participants' discussion and interest in knowing what was going on in physics at TYC's."

- "Problems Encountered: We are isolated and do need networks."

The second set of regional meetings, held during the spring of 1996 *(Proceedings of Regional Meetings, Spring 1996)* produced the similar comments:

- "The second [region] is larger [than the others] and is very isolated. They [the teachers in the region] are not involved in physics professional activities."

- "One participant who is the only physicist on his campus, stated that TYC21 provides a valuable service and his only opportunity for interaction with other TYC physics faculty."

- "[The feedback from regional participants reporting that the meeting was valuable and should continue] is a good indicator of the high degree of isolation many people feel."

The reality of isolation and its impact on student learning so impressed the network members that three regions (Regions 5, 10, and 15) selected isolation as the topic for the three-year regional study. (The findings of these studies are discussed later in this chapter.)

TYC21 data strongly suggest that the barriers of isolation cannot be broken until becoming "unisolated" becomes a personal need realized by the individual faculty member. Until the faculty members perceives isolation as a barrier to improved teaching or learning in the classroom, he or she will not attempt to break the barriers. The proceedings of the regional meetings during the spring of 1997 *(Proceedings of Regional Meetings, Spring 1997)* reflect what one regional coordinator had learned:

> **Many of the TYC faculty who are isolated...are doing so because of, quite simply, no interest in becoming un isolated. Sporadic conversations with non attendees seem to indicate that they are isolated and LIKE IT. As one attendee said, "The TYC21 assumes that the majority of isolated TYC [two-year college] physics teachers desire professional contact. That assumption could be wrong."**

During a presentation at National Meeting Two, Mary Beth Monroe (Monroe, 1997, p. 2) addressed this concern:

> **During the conception of TYC2l, I had conversations with some colleagues concerning some members of our profession who apparently sought teaching at the two-year college because of this isolation or singularity it offered them . ...One region suggests that TYC21 assumed all faculty wanted to become on isolated. That is not the case. What we the originators of TYC21 did assume was that the majority of two-year college teachers are committed to the quest for improving student learning and that this quest would convince the isolated to expand their activities beyond the classroom.**

Mario Caprio (1997, p. 243) offered further insights, describing the isolation he had viewed among two-year college science faculty members from his vantage position as editor of the "Two Year College" column in the *Journal of College Science Teaching:*

> **The reasons for isolation may be geographical, financial, social, or political – and more likely a combination of these. ...We work in isolation on problems that yield information that may well serve the common good, but we do not often share what we learn. ...Rather, educational institutions probably only rarely consider what they have learned about their own campuses to be of any more than local interest. ...Chief among the losses isolation brings are the inevitable redundancies it spawns. For no matter how specialized local needs may be, it is difficult to imagine that there is no educational institution somewhere that has not already wrestled with — and solved — precisely the same problem or some analog of it. Building atop the work of others promises an easier climb and would surely bring the climbers to even greater heights. But scientists have known that for centuries.**

One regional leader reported a similar sentiment when reporting on his region's Fall 1996 meeting, noting that "The other problem for some in our region is the feeling of isolation. I got a sense from this meeting that there is strong need to compare notes with others...People seem to need a structured environment to get to know each other before they begin to exchange ideas. These meetings provide that structure" *(Proceedings of Regional Meetings, Fall 1996).* Another regional leader, reporting on his region's Spring 1997 gathering, pointed out that "Isolation was a significant factor [in this region] prior to the advent of TYC21 because there was no mechanism for individuals to meet as physics teaching colleagues" *(Proceedings of Regional Meetings, Spring 1997).*

To the surprise of the project leaders, the 15 regional teams took it upon themselves, from the very beginning, to involve every two-year college physics faculty member in the TYC21 network. Apparently realizing the impact of isolation on their classrooms, the regional leaders sought to bring this realization to all of their colleagues. Many of the questions addressed during group activities at the National Meetings of TYC21 concerned the general question, "How do we get more faculty members involved?" Some expressed frustration at what they believed to be low attendance and even reported that the meetings were not successful because attendance did not increase over time to the extent thought it should. But they all emphasized that networking could not be imposed on the faculty. The regional reports indicated that the decision to become "unisolated" is a matter of personal choice.

Once colleagues could be convinced of the need for networking, it was important to provide for face-to-face contact. The project originators assumed from the beginning personal interactions were key; the project would simply not succeed if its networks were built largely on newsletters or other forms of impersonal communication. After a "comfort level" for communication had been established, the local networks would become stronger, and collaborative activities between meetings would evolve.

The regional reports suggest that the time needed to establish this comfort level among participants was about two years. During the first year, and for most of the second year, the regions reported that their activities entailed discussions of individual concerns related to performance in the classroom. It was primarily during the third year of the project that regional discussions and activities began to address issues that were more global in nature and to consider the impact of their local activities on other regions and the larger physics community.

...With Leadership

Planning and hosting meetings were new activities for many of the two-year college faculty members. Regional coordinators therefore received some training in leadership skills and team building at the AAPT-hosted retreat held at University of Notre Dame in August 1994 and at the subsequent Post Falls (idaho) retreat held in August 1995. The steering committee and TYC21 Project Manager also prepared a *TYC21 Meeting Handbook* to help regional leaders plan and evaluate local meetings. During the first two years of the project, the conversations between regional coordinators, regional team members, steering committee members and the TYC21 project manager provided the support and direction needed to "empower" two-year college faculty members as leaders in cooperative activities.

If a network is to become self-sustaining, and therefore safeguard against a future lapse back into isolation, leadership skills must necessarily be cultivated, particularly among new faculty members. TYC21 asked each region to elect a three-person leadership team for each of the three years of the project. During the course of the project, 82 different team members attended the national forums described in Chapter 4. These individuals, besides serving their regional colleagues, formed a backup leadership team for the project, filling gaps as individuals resigned. Seven of these team members eventually became regional coordinators; one of these individuals later became a member of the project's national steering committee.

The local leadership teams also helped combat the isolation produced by the geographic separation of two-year colleges. Many of the regions had team members from colleges in distant locations. For example, Region 4 (Utah, Arizona, Colorado, Wyoming and New Mexico) had team members from the Maricopa area in Arizona, from Farmington, New Mexico, and from Denver, Colorado. While most of the team members for the Texas-Louisiana region were clustered in East Texas, one team member was from El Paso Community College. Region 11, another large multi-state region (consisting of Alabama, Tennessee, Georgia, South Carolina and Mississippi) was led by team members from Brunswick, Georgia, Birmingham, Alabama, Goodman, Mississippi, Alexander City, Alabama, and Nashville, Tennessee. Even in the regions with greater concentrations of two-year colleges, such as those regions on the nation's east coast, leaders came from relatively disparate locations. For example, Region 15 (eastern New York, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut) had team members from Boston, Massachusetts; Berlin, New Hampshire; Danielson, Connecticut; Lincoln, Rhode Island; and Poughkeepsie, New York.

As the leadership matured, national project leaders took a back seat to the regional leaders. National Meeting Three (American Association of Physics Teachers, 1998) clearly belonged to the regional leaders; 40 of the 60 participants shared responsibility for some part of the program. During the TYC21 April 1999 Meeting (American Association of Physics Teachers, 1999a), the participants quickly rallied to the charge from the steering committee and with a unity of purpose formulated and adopted a community vision spanning the next five years. (See Chapter 4, pp.43.) This vision addressed the challenges facing the physics education community by defining five areas for action that two-year colleges can address as they revitalize introductory physics education.

The maturation of leadership also made the two-year college community more visible within the larger science education community. Many of the new leaders that emerged during the course of the project have served on NSF review panels and have been invited participants at NSF-sponsored conferences addressing science education policy. Some have been appointed or elected to leadership positions within the AAPT, including membership on the Two-Year College Committee. Tom O'Kuma, TYC21 steering committee member, compleed his presidency term with

AAPT; Alex Dickison is seeking another term as AAPT Treasurer, and Marv Nelson, TYC21 project director, received the prestigious AAPT Excellence in Undergraduate Teaching Award in August 1999. Other notable leaders include Aaron Wenger, Region 5 coordinator, who received the Carnegie teaching award; Ali Yazdi, Region 11 Coordinator, who was appointed to a statewide education committee; and Tim Dave, Region 2 Coordinator, who was named Adjunct Faculty Member of the Year in California. All point to the great leadership potential within the ranks of the community college faculty.

...With Communication

Region 10 participants produced a white paper concerning the erosion of isolation within their region. They concluded that enhanced communications would best solidify the local network. Barbara Bates, Regional Coordinator, wrote,

> **Out of about 120 people on the mailing list, about half had contact with members of the regional team. About 50 different individuals attended at least one of the regional meetings that we held throughout Kentucky and Ohio. Even though few traveled over 50 miles to a meeting, many people attended more than one meeting. Our region has a list serve and a web site. We are communicating more often using email. We found that two-year college physics instructors want to interact with people who do what they do. What we did was to create a structure that facilitated that interaction (Bates, 1997).**

This is thoroughly in line with the tenet, noted above, that face-to-face meetings are probably the best mode of communication among two-year college physics teachers. The meetings provide for informal chit-chat, allow time to identify with colleagues, and foster an exchange of information and ideas concerning pedagogy and professional development. TYC21 emphasized the "personal aspect" of networking with a focus on these meetings. Attempts were also made to capitalize on the interpersonal contacts made during the meetings to sustain communications between the gatherings. The intent was to increase the rate of communication between otherwise isolated professionals.

Scheduling Meetings

Altogether, the regions convened 93 meetings during the course of the TYC21 project. Planning and hosting these meetings required that regional leaders address the barriers of distance, time and money. Surprisingly, the latter problem — money — appeared to be the least troublesome of these problems. Although faculty members often cited the lack of financial support as a reason for not convening meetings, regions did not deplete the money available to them, using only 47% of those funds. TYC21 funding primarily provided support for consultants and guest speakers, while host institutions covered expenditures for postage, duplication, and (in some cases) food.

Distance and travel time posed the most difficult problems. Large teaching loads, compounded by the prevalence of single-member departments, do not provide much free time to attend meetings, particularly if a large amount of the time is spent in travel. Attendees traveled, on the average (one way) approximately 110 miles from their home institution to the meeting site, with an average travel time of 2.2 hours. Regional leaders employed several tactics to overcome the distance barrier. One approach, taken by six regions, was to hold multiple meetings at different locations. Regions also addressed the barrier of distance by locating meetings in urban hubs with relatively large concentrations of community colleges. These hubs included such areas as Los Angeles (Region 1), San Francisco (Region 2), Chicago (Region 8), Baltimore (Region 13), and the Seattle-Tacoma metropolitan area (Region 3). A third approach, used in Region 5, was to use interactive television (ITV). The two-year colleges in Minnesota already had the hardware in place allowing the regional coordinator to hold three informal ITV meetings per year (in addition to face-to-face meetings in Grand Rapids, Willmar, and Mankato). The maximum distance traveled for the ITV meetings was about 30 miles.

Distance notwithstanding, the argument used by some faculty members that "the meeting is too far away to attend" could not be substantiated. Half of the reporting regions indicated that participants traveled, on average, less than 100 miles between the home institution and the meeting site; the other regions reported that participants traveled between 100 and 200 miles on the average. In the end, the deciding factor was the individual faculty member's decision to get involved. This was aptly stated by John Enger in his final report concerning Region 4:

> **This is a large geographical area [Region 4]. In flying from Cody, Wyoming to Phoenix, Arizona, the only visible sign of human habitation seen is Salt Lake City, where plane changes are typically made. From the airplane can be seen a thousand miles of mountains and trees, and desert with such famous, but largely unpopulated places such as the Grand Canyon, Canyon Lands National Park, Zion National Park and Bryce National Park. Yet the isolation issue is not geographical, as one might guess. It appears to be more a choice of individuals. There are physics staff members in Phoenix more isolated than others in the lowest populated state in the Union, Wyoming. Information flow appears to be largely a matter of who is interested and willing to communicate, and has established a network with other interested individuals. (Steering Committee Final Reports, 1999)**

Communication Between Meetings

Sustaining communications between meetings, and reaching out to the as-yet uninvolved faculty members, was a formidable challenge. As the coordinator of one region noted in the fall of 1996, *(Proceedings of Regional Meetings, Fall 1996)*, "One of the critical issues of the national vision is reducing the isolation of TYC21 faculty. Extending our lines of communication does this!" In the following year, another regional coordinator reported that "So for those who are frustrated because we see the same people over and over again, we need to remember that before this project these folks were as isolated as the ones we are still trying to reach" *(Proceedings of Regional Meetings, Spring 1997).* Patti Hughey of Region 9 added similar insights:

> **We are still working on communication which will help reduce isolation. I am beginning to understand that it is not just the lack of mechanisms (meetings, newsletters, email, etc.) but also the time involved in meaningful communication that is part of the problem. In fact, I would suggest that this is the greatest part of the problem with isolation. Our teaching schedules keep us too busy to communicate on teaching and learning issues as well as keep abreast of current physics research. We each need to learn ways to incorporate more time for professional development and collegial support *(Proceedings of Regional Meetings, Spring 1997).***

During the early stages of the project, regional leaders relied primarily on mailings and telephone calls to communicate with colleagues. These early communications were aimed at identifying two-year college physics teachers within the region and disseminating information about the project. Mail contact was made with 2,000 of the 2,230 two-year college physics faculty members identified by the regional coordinators.

Later in the funding term, many of the faculty members acquired electronic communications through their colleges, and e-mail became a prominent communication mode within many of the regions. During the course of the project, TYC21 members also established 7 web pages and 2 "list-serves." It should be noted, though, that the regions had varying success using electronic communication. Region 2 reported that electronic communication had effectively institutionalized the TYC21 project and that the region's list-serve had been successfully used to plan meetings, recruit participants, and exchange information. On the other hand, leaders in Region 1 reported that its published newsletter, distributed regularly to 250 readers, proved to be a more effective communication mode than e-mail or other forms of electronic media. This reflects the very important point, emphasized throughout this monograph, that no one form of networking can be imposed nationwide; local regions must develop their own approaches to networking from the ground up.

In an effort to promote communication across regions, the TYC21 Project Manager e-mailed the project leaders a short and informal notice every two weeks. Called the "biweekly," this e-mail notice advised the TYC21 community of project deadlines, announced professional development opportunities, noted the dates and locations of future TYC21 meetings, and reported on new developments in government policy affecting the two-year college community. Each biweekly requested a simple one-word acknowledgement that the e-mail had been received. Cross-regional communication was also facilitated through the provision of travel funds that regional coordinators (as well as steering committee members) to attend TYC21 events held outside of their home regions. At least two thirds of the leaders attended at least one event in an outside region.

...With Scholarship

A desired goal of the communications efforts described above was increased involvement of two-year college physics teachers in scholarship on science teaching. At the end of the project, TYC21 participants could point to a number of scholarly achievements. As Marie Plumb, program chair for the third national meeting, put it,

> **"We have started collaborative activities, begun outreach programs, written grants, been awarded grants, given poster sessions, given papers, and sponsored meetings..."**
>
> **"Each of us is different because of TYC21. Our classrooms are different because of TYC21. Our students are experiencing physics differently because of TYC21. Some of the differences are easy to identify — we try a new lab or a new course. Some of the differences are more subtle — we listen more carefully to what our students are saying" *(Partners in scholarship: Proceedings of National Meeting Three of the TYC21 Project, 1998).***

In addition, the project's newsletter, *CONNECTIONS*, provided an opportunity to exhibit scholarship. The newsletter was circulated to all TYC21 participants and to others who, according to the American Association of Physics Teachers, taught physics at two-year colleges. Besides news on national issues affecting the two-year college community, *CONNECTIONS* published articles written two-year college physics teachers who addressed such topics as physics pedagogy and outreach to the community (including K-12 students, four-year colleges, and employers).

Regions were also asked to prepare "white papers" on critical issues in physics education. Some did so with notable success. For example, Region 3 produced a study of student competencies that continues to engage all local participants, as well as participants in Region 9. The study of lecture/lab parity conducted by Region 6 successfully engaged faculty members from both two-year and four-year colleges in a needed debate about this contentious issue. But for the most part, work on the white papers did little to break down faculty isolation. Most regional coordinators reported that the actual researching and writing required in the production of the papers engaged only one or two of the regional leaders.

Nonetheless, the TYC21 project demonstrated the great potential community college faculty members have to make significant contributions to science education. For example, the coordinator for Region 5, Aaron Wenger, coupled his regional study with another NSF-funded program, the Minnesota Lab Centered Instruction (LCI) project. As Wenger (1999) notes, the LCI project, initiated in 1997, sought to connect physics teachers with schools and employers, thereby decreasing the isolation of the faculty from the real world of the students. The result was a greater use of inquiry-based pedagogy and enhanced communication with fellow science and mathematics teachers at local high schools (Bedard, 1999).

Region 15 offers another example. Its white paper (Zito, 1999) examined the factors that contribute to faculty isolation in the Northeast. A tangible result of this effort was the development of PANIC – Physics ANswers in Cyberspace. PANIC uses computer technology to connect students at small to medium-sized community colleges with physics professors (and students) at institutions throughout the region. This collaborative effort greatly expands the range of expertise available to students who attend colleges with one-person physics departments.

...By Addressing A Common Goal

In 1995, TYC21 challenged community college physics teachers to gather in regional meetings that were to address locally-defined issues and lead to specific outcomes. Internal evaluations were to measure the extent to which these outcomes were accomplished. The tasks of specifying common goals for a meeting and measuring the outcomes of a meeting were new to most of the participating faculty members. Nonetheless, 67% of the regions submitted goals, outcomes and meeting agendas to the national steering committee (though it is not clear from the database if the regional teams developed their goals prior to the development of meeting agendas).

These reports aside, however, the project participants learned that success or failure of a meeting as a means of eliminating isolation depended largely on the extent to which it addressed a goal deemed important by all participants. During the national meeting convened in April 1999 meeting, Todd Leif of Region 7 and Bill Hogan of Region 8 commented that their most successful meetings occurred when activities were developed with a specific goal or theme in mind. Tim Dave of Region 2 and Myron Mann of Region 1 observed that communications between meetings were successful when there is a reason for members to communicate. Panelists at the meeting also shared their observation that the success of a meeting should not be measured solely on the basis of attendance. As Hogan put it, "regions must be allowed time to make mistakes and learn" (*A vision for tomorrow*..., 1999)

The first national meeting (*Realizing a vision...*, 1996) was a case in point. Sixty leaders from the two-year college physics community, aided by the presentations of Dr. James Palmer, Dr. Melvin George, and Dr. Karen Johnston, realized their common goal: to return to their regions with a commitment to improve the quality of physics education by helping isolated teacher to become "un-isolated." With a common focus on this goal, the 530 members of the 15 TYC21 regions have structured local activities that are successfully breaking the barriers that perpetuate faculty isolation. This goal was reiterated in the vision statement drafted by participants at the final national meeting held in April 1999:

> **As two-year college members of the physics community, we need to actively communicate and promote our belief that physics is an important part of all students' education. Further, we believe that physics teachers who regularly communicate with each other can share ideas and provide a better set of teaming opportunities for their students. Our network of physicists will sustain local and national conversations and activities about methods and styles of learning and teaching. These conversations and activities will support scholarship that is widely available, easily accessible, and invites commitment and collaboration (*A vision for tomorrow...*, 1999).**

Conclusions and Recommendations

The TYC21 project highlighted the leadership role that community colleges can assume in the reform of undergraduate education. Their close ties to local communities and industries, their ability to adapt quickly to changing educational demands, and their sole focus on teaching keep the community colleges in the vanguard of curricular change. Although the American Institute of Physics reports that there are only 2700 faculty members teaching physics on 1056 community college campuses, about 25 % of all students taking introductory physics at the college level are enrolled at two-year colleges (Neuschatz, et al., 1998). In addition, the *Shaping the Future* report issued by the National Science Foundation reported that two-year colleges enroll the largest percentage of college undergraduates, offer the largest percentage of undergraduate courses in science, mathematics, engineering and technology (Committee on the Review of Undergraduate Education, 1996). These data are summarized in Table 1.

It is therefore imperative that two-year college faculty members continue and enhance their collaborative scholarly work. Through these efforts they can overcome the isolation caused by geographical distance, limited time, lack of financial support, large workloads, single-member departments, lack of institutional support for scholarship, and the "agendas and views of those involved in graduate studies, especially at the doctoral level" (American Institute of Physics, 1998). Although the TYC21 project has received much recognition, there is little evidence that it has had an impact on the teaching faculty outside the two-year college community.

Table 1

SCIENCE, MATHEMATICS, ENGINEERING, AND TECHNOLOGY EDUCATION (SME & T), BY HIGHER EDUCATION SECTOR

Type of Institution	% of Enrolled Undergraduates	% of Undergraduate SME&T Courses	% of Undergraduate SME&T Enrollments
Two-Year Colleges	44	41	34
Research Universities	16	15	25
Doctoral Universities	9	9	10
Master's Universities & Engineering Schools	21	22	22
Bachelor's & Small Master's Institutions	10	13	9

Source: (Committee on the Review of Undergraduate Education, 1996)

The process of breaking down the barriers that perpetuate isolation is a continuing one. This on-going challenge was recognized by the external evaluator in her 1996 annual report (Norton, 1996). Success, ultimately, will depend on the decisions made by individual faculty members. Probably the most important discovery surfacing during the course of the project was that "isolation is ultimately a matter of personal choice" (Monroe, 1997, p. 9). If faculty members believe that their networking will improve student learning, they will work to find ways to become "un-isolated." Therefore, members of the two-year college physics community must continually foster communication, develop leadership within their ranks, and engage in scholarship on teaching. This is a responsibility that is shared by individual teachers, their institutions and the physics profession at large (both at the regional and national levels). While the initiative to become "un-isolated" must originate with the teacher, other members of the education and science communities can provide support and encouragement while fostering a "team effort" to improve the teaching and learning of all students.

Toward this end, we conclude with the following recommendations:

To The Individual Faculty Member:

- Attend and participate (present papers, conduct workshops, serve on committees) in local, regional and/or national meetings annually.
- Be enthusiastic and positive in your scholarly activities and/or professional development activities and share your knowledge and experience with others.

- Regularly engage in assessment and evaluation of physics pedagogy implemented in the classroom and maintain documentation of your findings.
- Collect information concerning the entry level skills and career goals of your students and maintain follow-up records for students completing your courses.

To College Administrations:

- Provide email and World Wide Web access for all faculty from their offices and homes.
- Institutionalize and implement professional development activities with reasonable financial support for all college faculty.
- Improve the reward system for faculty engaging in scholarship.
- Provide financial support to faculty (part-time and full-time) for both local and national meetings/workshops.
- Institutionalize campus activities engaging all faculty (part-time and full-time) teaching SME&T courses.

To TYC21 Regions:

- Identify reasons for communication between meetings and gatherings of two-year college physics faculty.
- Implement, on a periodic basis, communications engaging two-year college physics faculty at the local level.
- Cultivate activities and/or communications engaging faculty and students at other educational levels.
- Define times during professional meetings, formal or informal, during which two-year college physics faculty can meet as a small community, engaging in dialog of particular interest to the two-year college faculty.
- **Maintain communications, whether formal or informal, with faculty in other TYC21 regions. Add the names of other regional leaders to existing local electronic list-serves and/or mailing lists for newsletters and other announcements.**
- Provide the Assistant Executive Officer of AAPT with dates of TYC21 and related meetings at the regional level for posting on the AAPT Web page

To The American Association Of Physics Teachers:

- Establish direct ties between the two-year college Member-at-Large and the Committee on Physics in the Two-Year College (CPTYC).
- Solicit from CPTYC recommendations for membership on the Nominating Committee from among the two-year college faculty.
- Encourage, in addition to open CPTYC meetings, closed CPTYC committee meetings during regular AAPT meetings.
- Foster communications between CPTYC and the National Science Foundation (similar to the annual visit by the AAPT Presidents to NSF).

- **Promote participation by two-year college faculty in the Science Forums convened in Washington by the National Academy of Science, NSF and other appropriate professional organizations.**
- Cultivate collaborations of the AAPT/TYC community with other physics and SME&T communities.
- Provide limited financial support for hardship cases from among two-year college faculty to attend AAPT Topical Conferences including the Departmental Chairs Conferences.
- Improve the information exchange among all AAPT members regarding the scholarship at two year colleges (such as editorial comments in the ANNOUNCER describing the activities of the Integral Role Conference convened in March, 1997 and the ATE PI Conference convened each Fall).
- Archive important data emerging from TYC21.
- Maintain data regarding the institutional level of its membership.
- Maintain the AAPT Web page and dates for TYC21 and related meetings and activities at the regional level.

To The AAPT Committee For Physics in Two-Year Colleges:

- Review the Regional White Papers and report findings and action plans to the general two-year college community.
- **Appoint and support a two-year college teacher to enlist and maintain dialogue among the members of this community via the TYC21 national list serve.**
- Assume responsibility for the maintenance of the project newsletter *CONNECTIONS*, circulated nationally.
- Continually identify the issues of both local and global impact to the two-year college faculty.
- Maintain active dialog with the two-year college Member-at-Large to the AAPT Executive Board.
- **Review the recommendations from the TYC21 steering committee (found in white papers on networking, regional study of critical issues and isolation) and subsequently prepare formal recommendations to be presented to the AAPT Executive Board according to the outline suggested in the Action Plan below.**
- **Actively seek and involve new faculty in leadership roles within AAPT and the two-year college community.**

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EPILOGUE

Marie Plumb, Jamestown Community College (NY)

The end of external funding cannot mean the end of the TYC21 initiative. First and foremost is the responsibility of the community to continue the efforts. Secondly, those efforts of continuation which are already underway are to be commended and must utilize existing network to avoid revisiting a state of isolationism — albeit a less constricting state. Finally, the acceptance of the leadership by the Committee for Physics in the Two Year College (CPTYC) of the American Association of Physics Teachers (AAPT) is the lifeline that the project needs to continue its national scope.

Responsibility

"What is most important at ths juncture is that new initiatives do not suffer from amnesia about what is necessary for the change to succeed" (The National Center for Improving Science Education, *The High Stakes of High School Science*, 1991, p. 88).

This statement speaks to the responsibility incumbent upon each and every one of us to expand what has been started. The network was non-existent five years ago. It will require focused attention to remain viable. The network is the structure that facilitates growth and fosters collaborations and new ideas.

It is generally agreed that once you have been introduced to concepts of relativity and quantum mechanics, you can never go back and view the world the way you did before you understood those ideas. The same can be said for "life of a TYC21 physics teacher before TYC21" and "life after TYC21". Once an individual has experienced sustained involvement with a national network of colleagues, he or she cannot imagine life without that wealth of information and camaraderie. Participants have often stated that involvement in the national agenda of TYC21 has awakened a latent idea and given them the courage to implement it.

What about those who are new to the teaching profession? We, who have benefited directly from TYC21 have a profound responsibility to those who follow. If we are committed to the goals and objectives of TYC21, then we must guarantee that they will be sustained.

Directions

There are many reasons to believe that the effort is continuing. While the external financial support has ended, the energy initiated by this project has been conserved.

TYC21 has been the genesis for many activities that are still underway. Aaron Wenger has initiated an LCI (Laboratory Centered Instruction) Conference in the Minnesota region. This is a method for developing inquiry-based learning in the classroom. Faculty from community colleges and from high schools build instructional modules in math, science and technology. The project has expanded to a national conference. At the conference invited TYC colleagues share their active learning curricula with each other. Several other regional projects have been suggested and are in the process of extending the involvement of members of the regions. Some regions have already scheduled meetings through 2001 and beyond.

Several projects have benefited directly or indirectly from TYC21 involvement. MAPTA (Maricopa Area Physics Teaching Alliance) was a fledgling before TYC21. Cooperation between the two organizations helped MAPTA to become the very successful project it is today. Again, the main focus was bridging relationships between high schools and community colleges.

Adopting the Vision

The Committee for Physics in Two Year Colleges (CPTYC) of the AAPT has adopted the vision statement developed at the TYC21 April 1999 meeting. In doing so, they have accepeted the leadership role in addressing the five areas that have been identified: affecting the education of future teachers; providing physics for all; overcoming isolation; engaging in meaningful assessment; invigorating the introductory physics curriculum. Under the leadership and guidance of CPTYC all of these issues will be addressed at future national meetings of AAPT. While accepting this formidable task is a major commitment on the part of the CPTYC, the TYC21 project has provided the impetus and the framework for such an effort. The foundation for the continuation of the network is established. Continued use will allow it to grow. At this writing, the committee has planned an ambitious schedule of sessions at future AAPT meetings.

Each time any of these issues is addressed at a national meeting it should attract more members of the two-year college community to the national meetings. This will, in turn, strengthen the voice of two-year college teachers in the national organization. This is a natural way to identify leaders who could join the committee and thus expand the effort. Change is not an event. It is a process. We must continue the process.

TYC21

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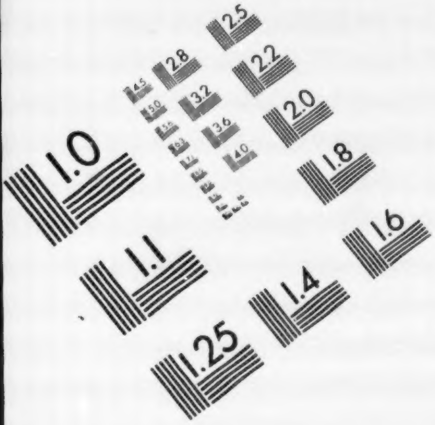
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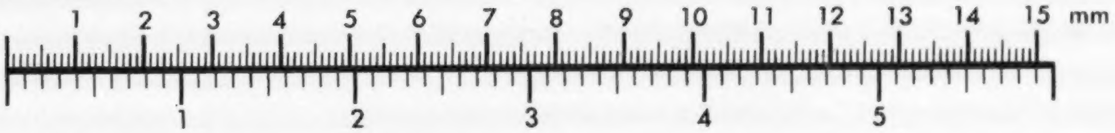
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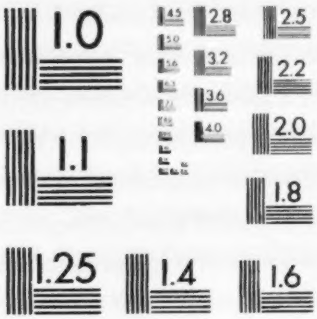
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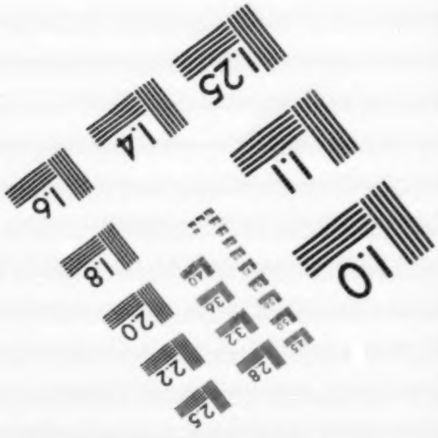
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